AT&T STARLAN NETWORK Marketing Guide

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II. INTRODUCTION

The AT&T STARLAN NETWORK is a low-cost, easy-to-install, and highly flexible PC network for interconnecting intelligent workstations. It allows PCs to communicate at speeds of up to 1 Mbps over standard telephone wire (unshielded twisted pair), and it supports both MS-DOS™ and UNIX™ System workstations on the same network. It is the network solution for businesses of all types and sizes that need PC connectivity for departments and work teams within the same building.

A. Organization of This Guide

This AT&T STARLAN NETWORK Marketing Guide is organized to give you the information you need to understand and sell the STARLAN NETWORK. It contains the following sections:

- **Introduction** (this section): Provides background information about PC networks and the PC networking marketplace.
- **Sales Strategy**: Describes the PC network selling cycle, explains how to identify and qualify STARLAN NETWORK prospects, describes the key selling features, positions the network among AT&T's other networking products, and provides suggested answers to commonly-asked customer questions.
- **Competitive Analysis**: Provides an overview of PC network vendors and their products, including key features, selling strategy, strengths and weaknesses.
- **Product Description**: Describes network capabilities and components in greater detail, including the various network configurations and services.
- **Support Plan**: Outlines the support plans available to STARLAN NETWORK customers.
- **Ordering Plan**: Describes ordering procedures for STARLAN NETWORK configurations.
- **Appendices**: Offer additional information.

B. The PC LAN Marketplace

The rest of this Introduction provides background information about the PC network marketplace. After reading this section, you will be able to:

- Explain the difference between a general-purpose network and a PC network.
- Tell customers about the benefits of PC-to-PC networking.
- Describe the PC network marketplace, its major players (and their market shares), and the impact of IBM® on that market.
- Identify major customer concerns regarding the selection and purchase of a PC network.
- Explain the special need for networked applications software, and discuss related software issues including site licenses and compatibility with standalone applications.

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- Understand why software standards, including NETBIOS, MS-DOS 3.1 and Microsoft Network's Core Protocols, are central to the sale of PC networks.

- Answer customer questions about important networking concepts, including client/server relationships and concurrent versus dedicated servers.

If you are already familiar with these topics, continue to the Sales Strategy in Section III.

1. General-Purpose and PC Networks

PC networks are part of the larger "local area network" market, which also encompasses large corporate terminal-to-host network systems. General-purpose and backbone networks, such as AT&T's Information Systems Network (ISN), primarily support interactive, high-speed communication for terminal-to-host and host-to-host applications. PC networks, in contrast, are optimized for the special needs of PC users. Unlike general-purpose networks, PC networks:

- Serve a smaller area (as opposed to a corporate-wide backbone network that may span large areas or more than one building).

- Interconnect intelligent devices (such as PCs) that have roughly the same computing power and CPU size (as opposed to networks for host computers and terminals).

- Use hardware that installs on the workstation (usually product-specific expansion boards that install in slots on the PC) instead of external, general-purpose hardware.

- Provide network applications appropriate to groups of intelligent devices, such as disk/file sharing, printer sharing, and messaging or electronic mail.

2. Benefits of PC-to-PC Networking

Personal computers and standalone workstations increase productivity, speed operations, and simplify calculations. Yet by definition, personal computers are just that: personal. They aren't designed to work together. Increasingly, businesses that use PCs feel the need to:

- Interconnect PC users on the same workteam to help them communicate and work together more effectively.

- Share the use and cost of expensive resources such as hard disks, printers, plotters, etc.

- Accelerate and facilitate access to shared information such as spreadsheets, documents, databases and programs stored on host computers or other PCs.

- Standardize master documents and software and keep work up-to-date by giving different users access to the same files.

- Extend the life of equipment and reduce obsolescence by introducing new capabilities for existing PCs.

PC networks address all of these needs by providing continuous, fast connection between personal computers

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located in the same work area. Networks serve as information highways, permitting users to transfer data, share files and printers, and communicate through electronic mail. Other "gateway" connections -- through modems, controllers, and the like -- allow workstations to communicate outside the PC network to mainframes and other devices.

In short, networks give the personal computer a bridge to the outside world. Individual users still work independently, but now they can reach out to other resources and other users. With the right network, a business can turn its fleet of separate PCs into a powerful, unified tool that translates individual productivity into departmental and work team results.

3. The PC Network Marketplace

Exhibit II-1 illustrates the market shares of leading vendors in the PC networking market today. As you can see, there has been a major redistribution of the market since IBM's introduction of the IBM PC Network™ (announced August 1984, first shipment April 1985).

IBM's introduction legitimized the market. Before IBM's entry, this market had been addressed by only a handful of small vendors. There were no industry standards, and customers were reluctant to purchase equipment without first seeing what IBM would do.

Current market leaders are IBM, 3Com and Corvus. IBM currently has two offerings: the PC Network and the more recently announced IBM Token Ring Network™. Although not shown in Exhibit II-1, Novell is also a key player and figures as a more prominent vendor/competitor than does Corvus. Novell has established itself primarily as a provider of high-performance network software. It has ported that software to all major LAN hardware and is successfully selling this solution. Since most industry consultants calculate market share on the basis of hardware/system sales, software vendors such as Novell are generally not represented in market share statistics. However, Novell should be categorized as one of the top five vendors.

4. AT&T's Advantage -- Sales and Support

When reviewing these competitors, note that, with the exception of IBM, none are prominent companies with strong sales/marketing and service/support organizations. Yet networking is generally new to users and requires them to revamp many of their ongoing procedures. As a result, support is a top priority for customers. AT&T now has a major advantage over competitors in our ability to offer a complete, interconnected product line, nationwide sales, and full-service support.

5. Customer Concerns

The arrival of PC networks has met with a mixture of excitement and caution from many businesses. Customers have some serious concerns that early networks -- as well as many currently on the market -- have not dispelled. Specifically, customers want and need:

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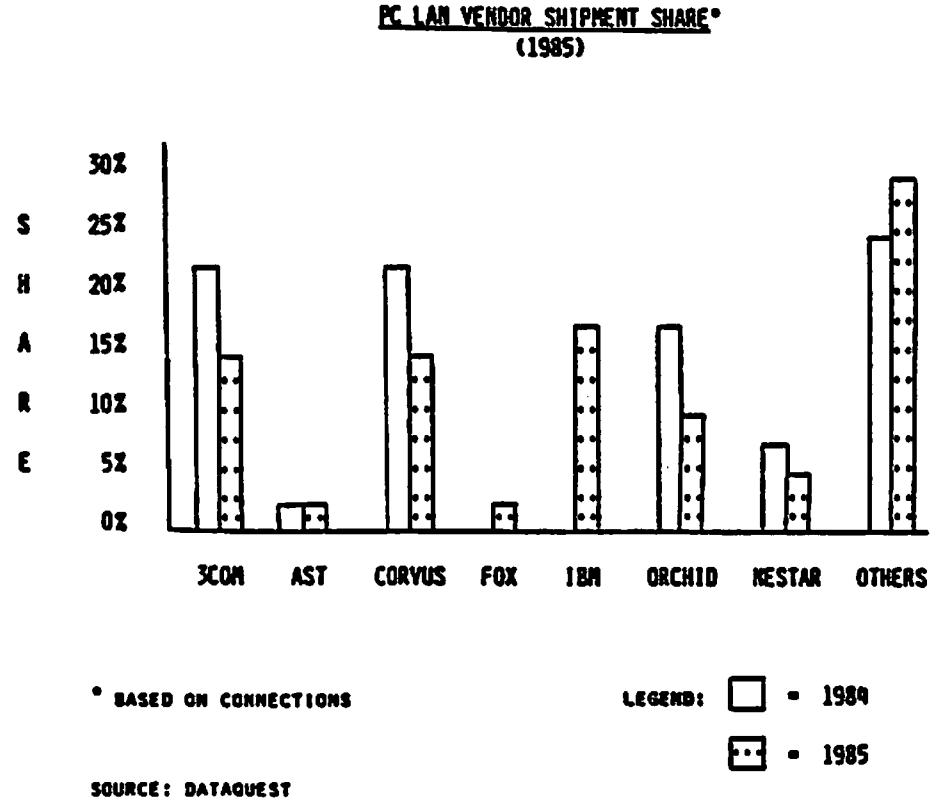
EXHIBIT II-1
PC LAN Vendor Shipments



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- A low-cost network that is inexpensive to install, uses existing telephone wiring, and connects to the PCs they already have.

- A network that permits small communities of white-collar workers to grow from standalone workstations to an integrated system -- without undue complications or upheaval. Such a solution must be cost effective for as few as two or three users, yet permit easy expansion.

- A way to expand, relocate, and reconfigure networks, without making old equipment obsolete and without requiring trained installation personnel.

- A network that conforms to industry standards for hardware and software to ensure current and future compatibility with the products they want to use, including all popular software, and the products of different computer manufacturers.

- A variety of file servers to meet their particular data storage requirements -- and file servers that can simultaneously double as user workstations.

- A LAN that protects their investment in existing MS-DOS equipment, without locking them out of the UNIX Operating System environment.

- A PC network that fits into the corporation's entire data communication system -- for complete connectivity beyond the confines of the department or work team.

- Reliable service and support that assures businesses that their network will stay up and running.

- A single source for network software, hardware and wiring -- so customers know whom to depend on.

For large customers who wish to integrate data and voice communications, making use of existing telephone wire becomes even more important. Additionally, those customers who want a complete data networking solution require a PC network that integrates seamlessly with their backbone general-purpose network.

Only one product on the market today offers a solution to all of these customer concerns -- the AT&T STARLAN NETWORK.

6. Important Software Issues

There are a number of issues concerning software that affect the PC networking market:

- Availability of networked applications.

- Acceptance of software standards.

- Network compatibility of standalone applications.

- Availability of software site licenses.

a. Networked vs. Standalone Applications

A standalone application is software that is designed to run on a single PC and support only one user at a time. A

networked application allows multi-user access to programs and data files, and it makes use of network capabilities such as file and record locking. These allow multi-user access to information while still protecting the files. For example, in a database application two users may read and change information in the same file at the same time, as long as both are accessing different records.

Customers need network-ready applications software to realize the full benefits of PC networking. Until recently, the lack of networked applications has hampered customer acceptance of PC networking. This problem is being addressed through the development of industry standards for networked software.

b. Emerging Software Standards

In the past, software developers had two options: tailor a program to a specific network's capabilities, or incorporate basic networking functions (such as record/file locking) into their own software. The first option limited the sales potential of the finished application, and the second was difficult and expensive.

Now, however, major network vendors including AT&T are adopting standards that make it more attractive for software developers to write networked applications. Developers know that their software will run on any network that meets the same standards -- whatever the underlying hardware, and no matter who the vendor is.

Three software standards are quickly establishing themselves in the PC networking market for the MS-DOS operating system. The AT&T STARLAN NETWORK conforms to all three standards:

- MS-DOS 3.1. This is the DOS version that incorporates record and file locking and provides support for programmers to write networked applications. Software developers who write programs under DOS 3.1 can be assured that their applications will be compatible on any networks that support DOS 3.1 as an applications interface, and will make use of DOS 3.1's record and file locking capabilities.

- Microsoft Net Core Protocols. In conjunction with MS-DOS 3.1, Microsoft released MS-NET™, a network operating system designed to be independent of network hardware. MS-NET, the IBM PC Network and Token Ring Network and the STARLAN NETWORK all use the MS-NET Core Protocols. Software for these products includes a Redirector program and file server programs with associated utilities. The Redirector reroutes workstation requests to another computer on the network using the MS-NET Core Protocols.

- NETBIOS. This stands for Network Basic Input/Output System. It has been incorporated into the IBM PC Network and the Token Ring Network. NETBIOS is a network equivalent of BIOS. It incorporates a series of low-level subroutines that enable applications developed to this interface to run on any NETBIOS-compatible network.

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Since the AT&T STARLAN NETWORK incorporates all of the above standards, it can run software written to those standards. Many vendors, including AT&T and IBM, have adopted the MS-NET Redirector, but most, including IBM, AT&T, 3Com, etc., have customized the file server program to provide better file and printer sharing, and to support concurrent servers as described below.

c. Problems with Standalone Software

Because of the way they have been designed, not all current single-user applications will run cleanly on a network, especially when more than one user is accessing the same files on a network hard disk. For example, the standalone version of Lotus™ 1-2-3™ closes data files after loading them, so another user can load, change and save the file while the first user is still working on it. Only the last person to save the file will have his or her changes recorded.

To avoid these situations, AT&T will provide and periodically update a list of applications, both single-user and networked, that run without difficulty on the STARLAN NETWORK. Also, in many cases, the network administrator can create DOS batch files that eliminate some of the difficulties involved in using Lotus, WordStar™, etc. These are documented in the Network Administrator's manuals.

d. Availability of Site Licenses

A major advantage for PC network customers is the ability to obtain site licenses for software. A site license allows all network users to run the same copy of a program. This can result in considerable cost savings. For example, a group of 10 users can purchase a single site-licensed software package, instead of buying 10 individual packages. Instead of paying perhaps $200 per package for each of the 10 users (at a total cost of $2,000), the customer could pay a single, lower fee (perhaps about $600) for a site license. A number of software vendors are changing their pricing structures to include site licensing.

7. Key Networking Concepts

The following are some concepts you will need to be familiar with when discussing PC networking with your customers:

a. Client/Server Relationship

Typically, a LAN for MS-DOS PCs has one or more servers. A server is any device that shares its resources (disk space, files, printers, etc.) with other workstations. These are typically devices with large disk drives that provide file storage for the network and control printers and other shared peripherals.

"Clients" (individual workstations on the network) use the server to share data, peripherals, and so forth. The number of servers and clients depends on the network design and configuration.

Customers are concerned about how many servers a network can support, whether they need to purchase expensive proprietary servers, and whether the servers are fast enough and provide enough storage space for their requirements. The STARLAN NETWORK is flexible about server

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support; it allows each device on the network to act as a workstation, a server, or both simultaneously. Also, the network permits a variety of devices, including general-purpose PCs (such as the AT&T PC 6300), to act as a server. (Additionally, a UNIX System PC or 3B2 may act as a server.) No special or proprietary server computer needs to be purchased.

b. Concurrent and Dedicated Servers

A dedicated server is a PC or other computer that acts only as a network server. Some networks, including the STARLAN NETWORK, allow servers to also act as user workstations (clients) at the same time. This is known as a concurrent server.

Concurrent servers allow customers to implement small networks without having to purchase a special server computer. As the customer's network grows, the purchase of a dedicated PC server will improve performance.

8. The Right Choice

Ultimately, the one thing your customers need to know the most is: which PC network is the right choice for them? The rest of this Marketing Guide will assist you in convincing potential customers that, whatever their size, industry specialization, and data networking requirements, only one product stands out as the right choice for PC workteam connectivity -- the AT&T STARLAN NETWORK.

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The AT&T STARLAN NETWORK At A Glance

Devices linked:	AT&T PC 6300. AT&T PC 6300 PLUS. IBM PC, IBM XT, IBM AT, and compatibles. AT&T UNIX PC. AT&T 3B1. AT&T 3B2 super-microcomputer. Asynchronous terminals. Asynchronous modems. All parallel and serial printers supported by the above computers.
Operating systems:	MS-DOS Version 3.1 and later. UNIX System V Release 2 and later.
Number of devices:	Up to 1210 physical connections. Up to 100 simultaneously-active workstations (recommended).
Maximum distance:	400 cable feet first to last workstation (daisy chain). 800 cable feet from workstation to central NEU (star configuration). Total maximum network diameter of 1600 feet.
Configurations:	Daisy Chain (maximum of 10 devices per chain). Single-NEU star (up to 11 NEU-connected devices, each leg can support up to 10 daisy-chained devices.) Two-tier star (one "master" NEU and up to 11 secondary NEUs).
Transmission speed:	1 megabit per second.
Transmission medium:	Unshielded twisted-pair wiring (baseband transmission). Compatible with AT&T Premises Distribution System (PDS). Often able to use the existing telephone wiring.
Connections:	Compatible with AT&T Information Systems Network (ISN) for connectivity throughout the organization.
Protocols:	IEEE Standard 802.3 CSMA/CD (Carrier Sense Multiple Access with Collision Detection). Microsoft Network's Core Protocols. MS-DOS 3.1 and NETBIOS compatibility.

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Command interfaces:	Menu-driven interface with windowing capabilities for easy use. Command-driven interface for experienced users. Interrupt levels for programmers.
Services provided:	
MS-DOS to MS-DOS:	Peripheral/printer sharing. File and data sharing (access to same file). Electronic mail (optional). Supports applications written to MS-DOS 3.1 or the NETBIOS Interface of the IBM PC Network (and IBM Token Ring Network).
UNIX to UNIX:	Peripheral/printer sharing. File and data transfers (access to copy of file). File and data sharing (future release). Remote program execution. Remote login. Electronic mail.
Mixed environment:	Peripheral/printer sharing. MS-DOS access to files/data stored on UNIX System file server.
File servers:	Any computer supported by the network may be used as a file server if provided with appropriate software and configured with the minimum memory requirements and a hard disk. UNIX System-only networks do not require a server; however, UNIX System devices may act as servers for MS-DOS workstations. One PC server can handle up to 16 simultaneous connections, depending on client activity. 3B2 servers support up to 32 connections. A workstation may access two or more servers simultaneously. Any number of servers may reside on the network. Any server may also be used concurrently as a workstation.

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Hardware:

AT&T STARLAN NETWORK Access Unit for each device:
- AT&T PC 6300 Network Access Unit for MS-DOS PCs.
- AT&T UNIX PC Network Access Unit for UNIX PCs.
- AT&T 3B2 Network Access Unit for 3B2 computers.

AT&T STARLAN NETWORK Extension Unit for star configuration.

AT&T RS232C STARLAN NETWORK Interface Unit for attaching asynchronous printers, terminals, modems, and host computers.

AT&T STARLAN Interface Module-C: Connection for connecting to ISN.

AT&T STARLAN Interface Module-B: Bridge for bridging multiple STARLAN NETWORKs through ISN.

Software:

AT&T PC 6300 Network Program (server and client software).

AT&T UNIX PC Network Program.

AT&T UNIX PC DOS Server Program (used when the AT&T UNIX PC functions as a server for MS-DOS workstations).

AT&T 3B2 Network Program.

AT&T 3B2 DOS Server Program (used when the AT&T 3B2 functions as a server for MS-DOS workstations).

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III. SALES STRATEGY

This section describes some of the key elements of selling PC networks. Having read it, you will be able to:

- Understand the PC network selling cycle.
- Identify the best prospects for PC networking solutions.
- Identify PC networking decision makers.
- Qualify the PC networking customer.
- Match the solution to the need.
- Understand the "hot buttons" of specific customer types.
- Position the STARLAN NETWORK relative to other AT&T networking products (PC Interface, 3BNet, etc.).
- Relegate the IBM solution to second place.
- Create some additional sales opportunities -- by using the STARLAN NETWORK sale to stimulate interest in other AT&T products.

Additionally, to save you time in developing a proposal for your customers, we have included a listing of STARLAN NETWORK benefits you may wish to use.

A. The Opportunity Unfolds

While the early 1980s was the era of the personal computer, PC networking is emerging as the second wave of the personal computing revolution.

- Customers Need It

While PCs meet the need for improved individual productivity, today's customer seeks more than an individual solution. People typically work in teams; therefore, they need a solution that links individual PC users.

PC networks do more than enable people in a work group to share data and communicate at high speeds. They reduce costs by eliminating the need to duplicate expensive hardware and software resources at every workstation; they provide convenience for workers who otherwise participate in printer and floppy swapping; they facilitate the standardization of contracts, specifications, financial models, etc. In other words, PC networks...

INCREASE PRODUCTIVITY.

- Customers Want It

PC networking, while a new market, has already gained enthusiastic customer acceptance. Market research indicates that an increasing percentage of workstations shipped to office workers will be attached to PC networks -- generally the same year in which they are bought.

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Year	Networked PCs (% of PC shipments)
1985	11%
1986	13%
1987	17%

And...while the objective of those buying PC networks is typically to reduce costs, research indicates that convenience and benefits of communication are what trigger follow-on sales.

This increased demand for networking represents enormous opportunities -- for customers and sales representatives alike.

B. Selling the STARLAN NETWORK

PCs have generally been an easier sell than the sale of larger systems (the mainframe or the department office automation system, for example). There are many parallels between the PC sale and the PC network sale, especially the STARLAN NETWORK sale.

- The Same Benefits

PCs provided the customer with three benefits: ECONOMY, EFFICIENCY, and CONVENIENCE. Additionally, the customer gained these benefits without losing PERSONAL CONTROL.

PC networking provides the same benefits, again without requiring the customer to forfeit personal control. PC networks enable you to maintain control over personal resources -- your CPU, your disk space, your files, etc. -- while providing you with the benefits of a departmental system.

- The Same Easy Sale

Since they don't represent an enormous outlay of monies, PCs don't require extensive needs analysis and justification. Even if the benefits of PCs are not apparent beforehand, they soon become evident. Meanwhile, the risk is negligible.

It's the same for PC networks. While PC networks are typically easier to sell than other products, the STARLAN NETWORK is especially so. It does not require the customer to make an enormous outlay of cash.

A small group of PC users -- let's say five -- in a small company or department can network themselves for the price of a couple of PCs. There is no need for extensive cost justification or lengthy feasibility studies, especially not with the AT&T STARLAN NETWORK. You can inexpensively network as few as two or three PCs. That way, customers can check out the benefits before they commit extensive financial resources. Nor does an MIS or corporate planning group need to fear expensive mistakes. They can easily and inexpensively acquire an evaluation system before setting corporate guidelines on PC network acquisition.

C. A Foot in the Door

BE PREPARED. There will be follow-on sales galore. PC networks are a great way to generate add-on sales. But you, as an AT&T representative, have an even better opportunity...

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- Penetrate New Customers

The keen interest in networking (and in the STARLAN NETWORK, in particular) provides you with yet another occasion to present the entire AT&T data products line to organizations that have traditionally purchased from other vendors.

- An Opportunity to Cross Sell

Because the STARLAN NETWORK unifies the customer's workplace, it gives you a natural opportunity to examine the organization's total range of needs. This positions you for a total system sale that includes our MS-DOS and UNIX System-based workstations, our full line of UNIX System processors, the Information Systems Network (ISN) as a backbone network, the AT&T MERLIN™ communications system, as well as our modems, printers, and other peripherals.

So, your initial sale of STARLAN NETWORK components was a small one -- perhaps it was little more than the Network Access cards to interconnect four or five people, a PC 6300 PLUS as a server, and some software -- but...

LOOK AT THE POTENTIAL.

You can upgrade the server to a 3B2 and interconnect some additional workstations in this same group. Then you can interconnect another group -- or two, or three, or four -- down the hall. By then, they should be thinking about an ISN, and some high speed connections (via ISN) to some 3B processors. And if they've been contemplating bringing in a new voice switch -- don't you think they'll consider AT&T?

Later on in this section -- after you understand the STARLAN NETWORK sale -- you will find some helpful tools to assist you in converting individual product opportunities into a total system sale. Just remember, every time you sell a STARLAN NETWORK, try to sell some of our other products too.

Conversely, every time you sell another AT&T product -- from a workstation to an ISN -- take a moment to qualify the customer for a STARLAN NETWORK. (We'll give you a hand with this one too.)

D. Customer Concerns

Lest you get complacent about this easy sell, there are some challenges...

Just as in the early stages of the PC revolution, many PC users -- your prospective customers -- have little knowledge of networking. This is a new product area and they don't always have confidence in their ability to make the right choice.

While many are convinced of the need, just as many fear moving forward. They want guidance on how to proceed on this purchase -- and YOU are the person who can significantly influence them.

One way to accomplish this is to stress our reputation for support. Except for IBM, AT&T is unique in the PC networking market. It has a large direct sales force; it is unsurpassed in installation and services support; and it has a fine reputation for documentation, training, and product support.

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While important for customers of all sizes, this level of support is especially critical for the smaller customer -- a five person law firm, a small consultant group, a remote and unsupported branch of a small corporation. These customers may not have the expertise in-house and thus have hesitated to install a network. Reluctant to acquire a PC network from the existing smaller vendors who offer little or no support, they find IBM's two competing (and more costly) PC networking solutions too confusing to sort out.

Once you understand the PC network market and the competitors out there, you too will be convinced that the AT&T STARLAN NETWORK is the right choice for your customers and that AT&T is the right company to provide the hand holding and support any new user requires.

E. The Target Customer

Many of you have found that customers are so excited by the STARLAN NETWORK that they have already approached you. But now you want to be proactive and are probably looking for some insight on whom to approach.

Almost anyone is a good prospect -- as long as they have a critical mass of PCs. And that critical mass is as few as two or three white collar workers using PCs.

The primary targets for the STARLAN NETWORK are workteams and departments with two or more PCs. The STARLAN NETWORK is optimized for two to fifty users per network (and can support up to 100 simultaneously active sessions, depending on the application). Since STARLAN NETWORK pricing is attractive for as few as two users, these work groups can be in small, medium or large companies.

- **Horizontal Applications Users**

We encourage you to sell to workteams that run horizontal applications like word processing, spreadsheet, data base and graphics packages (e.g., Microsoft Word, Lotus 1-2-3, dBASE III, etc.).

As described in the Introduction, applications written to MS-DOS 3.1 and NETBIOS should run on the network without difficulty. However, there are many standalone horizontal applications in the marketplace today that were not developed to either of these applications programming interfaces. This is even more the case for vertical (industry-specific) applications. Therefore, testing for network compatibility is important.

Ambitious as our testing program is, we cannot guarantee that the thousands of packages on the market will be fully tested in the near future. Therefore, in the early time frame, we encourage you to sell to customers using horizontal applications. (There are simply fewer of them to test.) Updated lists of tested applications will be provided to you periodically.

- **Vertical Application Users**

That does not mean that you cannot sell the AT&T STARLAN NETWORK to users of vertical applications, however. Because MS-DOS 3.1 and NETBIOS are

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quickly becoming standards, many vertical applications developers will have already written their software to these interfaces.

Ask whether the vertical applications the customer is using were written to MS-DOS 3.1 or NETBIOS.

Don't be discouraged if the answer is NO -- all is still not lost.

- -- These applications may still be compatible with the network but will require testing.
- -- You can still sell STARLAN NETWORK hardware -- for use with other third party network operating system software that supports those vertical applications.

Because the STARLAN NETWORK is an open architecture, third party vendors can easily be compatible with our hardware, which many admit is a superior alternative to other network hardware solutions. Novell and 3Com have already announced their intent to port their network software to run with STARLAN NETWORK hardware. Since there is a wide range of vertical packages that have been certified to run with these network operating systems, customers can buy STARLAN NETWORK hardware and use third party software.

A word of CAUTION. This approach is not without its drawbacks -- especially for large customers that intend to tie multiple STARLAN NETWORKs together via ISN. If the lower level protocols are not the same as those that are used on the STARLAN NETWORK and on ISN (we are using URP, Universal Receiver Protocol), users of third party software MAY NOT BE ABLE TO USE ISN FOR CONNECTING STARLAN NETWORKS.

Thus, one department in a large corporation using STARLAN NETWORK hardware and third party software may not be able to use ISN to communicate with another department down the hall that is using STARLAN NETWORK hardware and software. Therefore, we strongly urge you to sell the total STARLAN NETWORK solution, including network hardware and software, when selling to large companies. That is not a severe restriction since the large majority of work groups run general office productivity applications, rather than vertical applications.

Selling STARLAN NETWORK hardware to run with third party network software that supports verticals may not be a problem, of course, with smaller companies, where there is little likelihood of their having multiple networks.

- Target Industries

Because the PC network market is still embryonic, there is insufficient data to identify what markets networks are being sold in. However, the market for PC networks is directly linked to the PC market -- and we have a good handle on the industries into which PCs are being sold.

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In a recent study of PCs and office workers, Future Computing identified a series of vertical markets that represent an excellent selling opportunity for PCs. These industries constitute a high percentage of U.S. white collar workers, have high penetrations of PCs, and expect to continue automating. These should also provide excellent opportunities for STARLAN NETWORK sales. These industries are (not in order of importance):

- -- Manufacturing
- -- Retail, Wholesale and Distribution
- -- Banking/Finance
- -- Insurance
- -- Education
- -- Transportation
- -- Medical
- -- Construction
- -- Law
- -- Real Estate

Limited experience has already shown that the education market is one of the best markets for local area networking. This single market already accounts for over 15% of all network sales.

REMEMBER, however, that while the need may vary from industry to industry, there is an application for PC networks ACROSS ALL INDUSTRIES, even those not listed. Don't exclude any industry not on this list from consideration as a prospect.

- Target Occupations

Some occupations represent better opportunities than others for PCs, and by association, for PC networking. These are:

- -- Engineers, Scientists and Architects
- -- Business Managers
- -- Administrative Support Personnel
- -- Accountants and Bookkeepers
- -- Sales Representatives

Again, don't exclude any potential customers just because they don't have one of the above titles. If they use a PC, they're a prospect.

- Target Company Sizes

As we have noted, almost any size company is an excellent target for PC networking. It all depends on how many PCs they have. It is clear that large companies are an excellent target by virtue of the number of white collar workers and penetration of PCs.

However, DON'T EXCLUDE SMALL COMPANIES and branch locations of medium and large companies.

The number of PCs in small locations is growing rapidly, as are DP expenditures for white collar workers in these companies. Additionally, while verticals are clearly on the rise, most PC users use standard horizontal software packages. The most popular management software packages used by small businesses today include the old stand-bys like Lotus 1-2-3 and Multiplan™.

There are other reasons why small companies make excellent prospects:

- -- They typically have a shorter selling cycle -- the decision maker is generally the owner so they don't have to get the entire company to sign-off on a decision.

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The implementer/user is an office manager, not an MIS Director.

-- They have little in-house system/DP/software expertise and welcome a corporation that can provide a strong helping hand. Also, as we have already noted, service is critical so we can make our mark easily.

-- They require turnkey solutions; they want software and hardware from a single vendor. A system solution, with STARLAN NETWORK hardware and software, AT&T workstations and processors, etc. -- all installed and serviced by a single vendor -- is a welcome product.

- Target Buyers

While PC networks are bought by large and small companies, we find that the sale may have to be made to different audiences within those companies. Target buyers (not necessarily decision makers) for PC networks are as follows:

-- Small Companies
- Work Groups, Departments, etc.

-- Large Companies
- Corporate Evaluation Staffs
- End User Groups (Departments, Branches, Work Groups, etc.)

Selling end users will be similar for both large and small companies. However, the sales cycle for corporate evaluation groups differs. How to sell to these different organizations is dealt with in detail later in this section.

This information should get you started. If we communicate a single message, it is:

DON'T prematurely EXCLUDE anyone.

Remember, if they have two or more PCs, they're a target customer.

F. Qualifying the Customer

You now know generally where the best opportunity for selling the STARLAN NETWORK lies, as well as who the decision makers are. Most corporate evaluators know the benefits of networking and are basically out to evaluate systems and establish corporate purchasing guidelines for end user groups. These groups generally are familiar with the end user groups that would most likely benefit from PC networking.

If you are selling to end users, on the other hand, you may need some help in qualifying them as potential PC networking customers. Before you can convince them that the STARLAN NETWORK is the right solution, you need to convince them that they need PC networking.

We have provided a list of qualifying questions to help you do this. Remember that any customer with two or more PCs in a given work group, department, small company, etc. is a good prospect and therefore should be asked the questions we have provided in Exhibit III-I. If

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EXHIBIT III-I

Qualifying the Networking Customer

A customer with two or more PCs in a given work group, department, etc., that answers "yes" to one or more to the following questions is a prospective PC network customer.

		YES	NO
1.	Do the PC users frequently need to share files?	____	____
2.	Are you considering upgrading some or all of these PCs to a hard disk?	____	____
3.	Do the PC users work on the same spreadsheets, reports, or documents?	____	____
4.	Do you have a laser printer or other expensive high-speed printers that you would like to share?	____	____
5.	Are you considering acquiring dedicated printers for each PC for greater convenience?	____	____
6.	Do you want to reduce expenditures on multiple copies of popular PC application software?*	____	____
7.	Have you considered the advantages of using electronic mail?	____	____

* A number of software vendors are making site licensed versions of networked applications available. This would permit a work group to legally acquire a single copy of an application -- at a reduced price -- to run on the network and be available to all network users.

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they answer yes to one or more of these questions, start selling them on the STARLAN NETWORK.

G. Selling Approach

As with any sale, successful STARLAN NETWORK sales depend on customizing your presentation to the specific needs of your customers -- and ensuring that there is a match between their needs and our solution.

Accordingly, this section discusses the different selling approaches to use with each of the following target customers:

Company Size	Target Customer
Medium/ Large	Corporate Evaluators Branch Locations End User Groups
Small	Small Workteams

For each target customer we have identified a series of key needs, or "hot buttons," summarized in Exhibit III-2. Note that the needs/interest areas for end users in large and medium companies (departments, work groups, branches, etc.) are very similar. Corporate evaluators and planners, on the other hand, use some additional and/or different criteria to judge solutions.

We will deal with these hot buttons in more detail throughout our discussions of selling approaches to individual organization types.

1. Selling Medium and Large Organizations

Different organizations follow different procedures when purchasing PC networks. Therefore, the target customers, their titles and purchasing authority will vary. In general, the approaches to network acquisition are:

- **Central Product Evaluation and Policy**

In many companies, networking products must be formally evaluated and certified as a corporate standard before they can be purchased by end user groups. (They may network a user group as part of the evaluation.) By establishing corporate guidelines they hope to avoid the proliferation of incompatible networks that will not be able to communicate in the future.

Given the strategic importance of networking to the corporation's information strategy, persuading these individuals to authorize the STARLAN NETWORK as an acceptable networking product is essential to long term sales.

- **Internal Consultants**

These are central evaluation groups whose role is advisory -- they do not have the authority to set standards or prohibit purchases by end users. Nevertheless, you should seek their support.

- **Direct Purchases by User Groups**

In some large organizations there is no corporate evaluation performed. Focus directly on individual workteams.

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EXHIBIT III-2

Hot Buttons -- By Customer Type

	Small Businesses	Medium/Large Evaluators	Medium/Large User Groups
Total Data Networking Solution		x	
Corporate Cabling		x	
Open Architecture and Standards		x	
Voice/Data Wire Integration		x	x
Price	x		
Low Cost Start-Up	x		x
Growth Flexibility	x	x	x
Configuration Options		x	x
MS-DOS/UNIX System Support		x	
IBM Device Support		x	x
Interdepartmental Connectivity		x	x
Turnkey Systems	x		
Off-the-Shelf Software	x	x	x
Services/Support	x	x	x

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To accommodate these different purchasing and decision-making profiles, we have separate strategies for selling to these groups.

a. Selling the Evaluation Team

Lack of urgency typifies this sale; evaluation and certification typically lasts between 30 and 90 days, but may last longer. This group needs to evaluate numerous systems before establishing guidelines. Therefore, anticipate a lull after the initial sale of evaluation systems.

Although corporate evaluators will be impressed by STARLAN NETWORK as a standalone product, their concerns go far beyond that and include:

- Connectivity
  - -- Ability to support a wide range of devices (including multi-vendor).
  - -- PC-to-host and host-to-host connectivity.
  - -- Network-to-network connectivity.
  - -- PC connectivity to inter-premises data trunks.
- Physical Distribution
  - -- Lowest cost wiring options. (Wiring up a whole company for networking gets expensive.)
  - -- Standard cable scheme that supports voice and data devices (especially for new buildings).
  - -- Networks that accommodate existing wire if possible and do not require complete rewiring.
  - -- Low maintenance costs.
- Simplifying Movement of Personnel

With constant rearrangement and physical moves, evaluation teams seek solutions that minimize the impact on productivity.

From this list you can see that they need to plan for growth and so will be evaluating backbone networks and cabling schemes as part of this effort -- and that takes time. They will be especially interested in how the STARLAN NETWORK will fit into their overall networking environment. They're afraid to make a mistake with long-term implications. Thus, you may find the selling cycle longer than when you are selling to end users.

To meet their concerns and close the sale, focus on the following:

- Describe AT&T's Total Data Networking Solution

Position the STARLAN NETWORK as part of a three-tier solution consisting of PDS, ISN and the STARLAN NETWORK. See Exhibit III-3 for a complete discussion of how to present this concept. This is a unique advantage -- even IBM has announced only pieceparts. Communicate it to your customer.

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EXHIBIT III-3

AT&T STARLAN NETWORK: Part of a Total Data Networking Solution

The AT&T STARLAN NETWORK is part of an integrated three-tier local and wide-area networking architecture that consists of a family of AT&T products, including the AT&T Premises Distribution System, the AT&T Information Systems Network, and the AT&T STARLAN NETWORK. Each of these elements represents a standalone solution to a particular problem; together, they provide a complete corporate data networking solution.

- Premises Distribution System (PDS): At the foundation of the network architecture is PDS. PDS provides a complete corporate wiring scheme using a fiber optic backbone, twisted pair distribution and convenient cross connect hardware. AT&T's voice and local area network products are built on this distribution scheme. The AT&T STARLAN NETWORK also accommodates older non-PDS twisted pair wiring solutions, but users planning cable requirements for new buildings can install PDS, assured that the STARLAN NETWORK will run on this cabling scheme.

- Information Systems Network (ISN): ISN is a facility-wide network which handles asynchronous and synchronous traffic and provides high-speed multiplexed access to host computers. ISN is a general purpose network providing host-to-host and terminal-to-host connectivity and, as such, relies on the AT&T STARLAN NETWORK as a complementary component to provide high speed intelligent workstation connectivity.

- AT&T STARLAN NETWORK: The STARLAN NETWORK is designed to interconnect intelligent workstations. It can function as a standalone product for departments or work groups that need PC networking. In environments with sophisticated data processing and information sharing requirements, the STARLAN NETWORK can be integrated with ISN. In this scenario, ISN forms the backbone network, tying together multiple STARLAN NETWORKs and providing workstations on the STARLAN NETWORK access to ISN hosts and services. Customers can begin with the STARLAN NETWORK and eventually grow into a total networking solution involving PDS and ISN.

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An important aspect of the AT&T networking solution is the FLEXIBILITY with which customers can expand their systems. They can start with a single STARLAN NETWORK and eventually grow into a total networking solution that involves PDS and ISN. Or, they can start with an ISN and acquire one or more STARLAN NETWORKs to interconnect intelligent devices.

- Position AT&T's Solution as Superior to IBM's

AT&T surpasses IBM -- both in the completeness of its total solution and in the superiority of the STARLAN NETWORK as a standalone PC networking product. See Section J.6. in this Sales Strategy section and the analysis of IBM in the Competitive Analysis section for a complete discussion.

- Present STARLAN NETWORK Strengths

Focus on areas of greatest interest to evaluation teams:

-- Simple, Low Cost Wiring: Easy to install and maintain, our twisted pair wiring scheme provides a low cost way to connect workstations throughout the organization.

-- Flexible Configurations: A variety of modular, flexible configurations simplify personnel reorganization and geographic movement and permit integration of voice and data wiring.

-- Growth Flexibility: Ability to grow from a departmental network to a total building or corporate solution -- without costly changeouts.

-- Conformance to Standards: Open architecture and conformance to standards permits the STARLAN NETWORK to support off-the-shelf software, accommodate a wide range of devices (including IBM and compatibles), support multiple operating systems, etc.

- Stress That We Are Partners in Support

Large companies typically have in-house support groups whose mission is to provide help to end users. Win their support by assisting them in establishing internal training programs, support programs, etc. See Section VI, Support Plan, for a complete list of training programs, documentation, and support materials available to customers.

If possible, establish a pilot or demonstration project within an end user organization. Usually, this happens as part of the overall evaluation of the product. If it doesn't, suggest it.

Corporate evaluators may seem like a tough sale, but think of the opportunities. While you wait, just picture all those follow-on sales.

b. Selling to the User Group

In most large organizations there is a wide range of end user groups, each of which is a potential STARLAN NETWORK customer. These groups include departments, work groups, branches, etc. These groups typically

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need a PC network to get a job done and will not linger over their decisions.

In many cases, these groups will simply order the STARLAN NETWORK from a central organization, based on corporate guidelines. In other situations, it will be necessary to make a direct sales presentation since they will be responsible for the selection of a network.

If you look back at Exhibit III-2, you will note that for the most part, you should sell these groups on the same benefits as you would sell to small businesses. However, work groups in medium and large corporations are generally not as price sensitive as their counterparts in smaller organizations.

Additionally, they will want to connect to other departments within the corporation, and while they will typically not purchase their own ISN, they will be interested in the availability of an ISN backbone.

In selling to end user groups in large and medium corporations, focus on the following selling points:

- Growth Flexibility: We can grow to support up to 100 active users WITHOUT expensive hardware/ software changeouts. Additionally, our range of servers will meet their needs as their requirements grow.

- Low Cost Start-Up: Our start-up costs are typically 10-30% lower than those of our competitors. This is due to the availability of low cost wiring and the daisy chain configuration, which requires no central hardware.

- Compatibility with AT&T Products: We are committed to providing support for current as well as future AT&T workstations and processors on the STARLAN NETWORK, as appropriate -- and using these devices as servers on the network. Additionally, through our ISN connection, we can support high speed access to larger 3B processors, access our voice switches such as System 75 and 85, etc.

- Support for IBM Devices: PCs -- especially IBM PCs -- have penetrated large corporations rather quickly and now these customers find it important to support these devices on their departmental network. The STARLAN NETWORK supports IBM PCs™, XTs™ and ATs™ -- with the same plug-in card used on the AT&T PC 6300.

- Interdepartmental Networking: As multiple departments in the corporation are networked, the customer can use an ISN to link these work groups and provide enhanced communication services.

- Support/Service: Although these groups have access to internal resources, they look to vendors for much of their end user support. Emphasize our nationwide service, numerous installation options, 24-hour hotline, comprehensive training and quality documentation.

While it is possible for the customer to use third-party network operating software, this is strongly discouraged for user groups in a large corporation, unless the software is compatible with ISN's URP protocol. The use of incompatible

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software would prevent this department from using ISN to connect with other STARLAN NETWORKs in other departments. (Note that this caution applies to network operating software, and not to applications software.)

2. Selling Small Organizations

In an earlier discussion, we indicated that small companies are excellent prospects. To summarize:

- They have a short selling cycle.
- The decision maker is generally an owner or office manager and doesn't consult with numerous others.

Small organizations are typically concerned about:

- Cost: Most small businesses are extremely price-conscious, so stress that the STARLAN NETWORK provides low start-up costs. In particular, emphasize:
  - -- Our prices are typically 10-30% less than our competitors for start-up configurations;
  - -- Entry-level daisy chain configuration requires no central hardware;
  - -- Low cost twisted pair wiring;
  - -- Concurrent server option.
- Growth Flexibility: We can grow to support up to 100 active users WITHOUT expensive hardware/ software changeouts. Additionally, our range of servers will meet their needs as their requirements -- and company -- grow.
- Robust Features: The STARLAN NETWORK is an excellent standalone PC network -- superior to IBM's solutions both from a hardware and software perspective (see Competitive Analysis).
- Investment Protection: We support a wide range of workstations (including IBM and compatibles) and off-the-shelf software so what they have bought does not become obsolete.
- Ease of Use: Since they can't provide much of their own support, they'll be impressed with our end user interface consisting of menus and windows, as well as our diskette-based end user training.
- Service/Support: We have a complete hardware and software solution -- and it comes with nationwide service, numerous installation options, a 24-hour hotline, comprehensive training, and quality documentation.

Small customers prefer turnkey solutions and as we said before -- we can provide a complete network, replete with workstations, and all are installed and serviced by a single vendor. Remember, that's important to this group.

However, if for some reason they want to use STARLAN NETWORK hardware but are reluctant to change out their software (they may not want to relearn a user interface, or they don't know if their vertical application has been tested out), they can also use our hardware with their third-party software.

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3. Selling Resellers

Resellers also present an excellent opportunity for the STARLAN NETWORK. This group resells to companies of all sizes that are interested in a customized data processing solution. Today, many VARs sell standalone computer solutions -- however, as we have already discussed, the future of the personal computer revolution is the system solution. Therefore, the emphasis when selling to this target group should be on helping these resellers make the transition from providing standalone solutions to providing a system solution.

AT&T is committed to supporting VARs and ISVs as they develop customized software for the STARLAN NETWORK. Two documents (the Technical Reference Manual and the Application Programmer's Reference Guide) have been designed for this purpose. In addition, the AT&T STARLAN NETWORK Technical Overview Course is available to familiarize decision-makers, technical professionals, and management personnel with the capabilities of the STARLAN NETWORK.

H. Using STARLAN NETWORK Sales Support Materials

Exhibit III-4 provides a listing of the available STARLAN NETWORK sales support materials to assist you in your sales activity. Here are some suggestions on ways to use these sales aids.

- Prospecting/Qualifying: When approaching a customer, use the AT&T STARLAN NETWORK Reference Card to jog your memory for a brief product summary, qualifying questions, key selling features, configuration guidelines, etc.

- Customer Seminars: Use the following materials in customer presentations and branch seminars:

  -- Customer Slide Presentation.

  -- Customer Video.

  These are excellent for launching the session and focusing the target audience. Tailor the remaining discussion, demonstrations, and question and answer sessions to specific customer needs. (Bone up on the correct answers to some typical questions in the Question & Answer discussion you'll find later in this section.)

  At the end of the seminar, be sure to distribute copies of the:

  -- AT&T STARLAN NETWORK Brochure;

  -- AT&T STARLAN NETWORK Customer Guide (this is specifically tailored to evaluation groups in medium and large businesses);

  -- AT&T STARLAN NETWORK Introduction (appropriate for work groups in any size business).

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EXHIBIT III-4
AT&T STARLAN NETWORK Sales Support Materials

- **AT&T STARLAN NETWORK Customer Video:**
  A short video presentation focusing on a typical workplace and why the STARLAN NETWORK is the right solution. Selling features and benefits are presented through a customer situation. The video is appropriate for large and small customers.

- **AT&T STARLAN NETWORK Slide Presentation:**
  Slides and script for a 45-minute sales presentation. It is designed for audiences already comfortable with networking concepts and seeking more information about key STARLAN NETWORK features. It contains optional slides and can easily be tailored for customers of all sizes.

- **AT&T STARLAN NETWORK Customer Guide:**
  A full color brochure explaining how the STARLAN NETWORK fits into the large and medium company.

- **AT&T STARLAN NETWORK Introduction:**
  A full color brochure explaining how the STARLAN NETWORK fits into the small company. This brochure is also appropriate for end user groups in medium and large companies.

- **AT&T STARLAN NETWORK Brochure:**
  A full color brochure explaining the network components. Acts as a supplement to the Customer Guide or Introduction. Appropriate for all customer sizes.

- **AT&T STARLAN NETWORK Reference Card:**
  Pocket-sized reference card provides a brief product summary, configuration guidelines, qualifying questions, price element codes, etc.

- **AT&T STARLAN NETWORK Demonstration Diskette:**
  An introduction to STARLAN NETWORK functions. Runs on the AT&T PC 6300 and can be used with or without the AT&T STARLAN NETWORK. Allows a customer to select areas of specific interest for greater detail.

- **AT&T STARLAN NETWORK Design Guide:**
  Easy to follow explanation of the STARLAN NETWORK and its configurations for the prospective buyer who needs more details on components and installation.

- **AT&T STARLAN NETWORK Configurator:**
  A computerized means of configuring a network to customer specifications. You can also use the manual configurator provided in this Marketing Guide.

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- Needs Analysis: Do some fact finding to determine basic customer requirements:
  - -- Business objectives/needs relating to networking.
  - -- In-place hardware/software.
  - -- Number of users/type of applications the proposed network will support.
  - -- Layout of physical facilities in which the network will run.
  - -- Additional equipment (workstations, peripherals, memory, etc.) to meet business, as well as networking, objectives.

The AT&T STARLAN NETWORK Configurator is a useful tool for gathering some of this information. It enables you to take inventory of existing equipment and identify the STARLAN NETWORK components required for a given configuration.

- Demonstrating the Product: Your presentations and demos should highlight the ways in which the STARLAN NETWORK will improve the target customer's ability to run its business. In making your presentation, incorporate the AT&T STARLAN NETWORK Customer Slide Presentation and Demonstration Diskettes. This demo, which runs on the AT&T PC 6300 or compatibles, provides an overview of PC network benefits and an introduction to the STARLAN NETWORK. It is not meant to be a demonstration of how the network operates. We will be providing this kind of demo in the future.

During the presentation and demo, and in the open discussion that follows, be sure to:

  - -- Tailor What You Say: Tailor the presentation to the customer's needs. For example, if their primary concern is physical installation, show them through visuals (our support materials and Design Guide have plenty of those) how simple it is to install.
  - -- Vary the Workstations: Try and show them the range of devices our network can support. If they currently have PC 6300s, provide a configuration with a PC 6300 PLUS as a server... or put on some UNIX PCs. They may decide that that's just THE workstation for them. If they have IBM equipment, assure them that we will support those devices as well.
  - -- Focus on Their Applications: Although the demo should begin with a walkthrough of the key features, its success largely depends on showing them things that relate to their business and applications. For example, if Lotus 1-2-3 is a primary application, use it in the demo.

- Develop a Proposal: This is part of standard practices when selling to large corporations. However, even a department or small business that doesn't expect a proposal will be impressed if you develop one for them.

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The proposal provides an opportunity for you not only to remind them of your product's strengths one more time, but also to show off your own professionalism. It tells the customer a lot about the company they're dealing with.

We have provided a suggested proposal outline in Exhibit III-5. Additionally, so that you spend your time selling rather than developing proposals, we have provided some generic text on customer benefits in Exhibit III-6. Be sure to select those items that are appropriate to YOUR customer.

- Informing the Customer: Some customers may want in-depth technical or configuration information before they move ahead. In those cases, the following documents may be appropriate. These documents differ from each other in their level of detail and technical content.

  -- AT&T STARLAN NETWORK Design Guide.

  -- AT&T STARLAN NETWORK Technical Reference Manual.

Some of the end user/system administrator documentation may also be helpful. You may also suggest that the customer enroll in one or more of the available STARLAN NETWORK training programs discussed in the Support Plan of this Marketing Guide.

- Concluding the Sale: An important part of closing every sale is reviewing the next steps with the customer -- including installation, training and service. Be sure to discuss the following:

  -- Pre-Installation Visit: Determine exact measurements, workstation locations, etc.

  -- Installation: During installation, the service technician will also cover introductory procedures with the users (e.g., explain the basic hook up of the network, review essential operations, etc.). NOTE: User training is NOT provided by the technician.

  -- Training: Indicate that the customer may need or want some training to support the AT&T STARLAN NETWORK. Both computer-based and instructor-led classroom training for decision makers, support groups, end users, and system administrators is available.

I. Cross Selling as Part of the STARLAN NETWORK Sale

As indicated previously, the STARLAN NETWORK provides you with an excellent opportunity to sell other AT&T products. A PC network is a natural foundation for a total system sale which includes workstations, processors, software, modems, etc. Selling a STARLAN NETWORK provides you with an ideal opportunity to help your customer identify a need for other products. Exhibit III-7 provides you with some leading questions to ask to accomplish this.

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EXHIBIT III-5

AT&T STARLAN NETWORK Suggested Proposal Outline

I. **Our Understanding of the Customer's Requirement**

-- Define the customer's requirement in your own terms.

II. **The STARLAN NETWORK Product Description -- Advantages of the AT&T Solution**

-- Highlight the key selling features of the product that track with the customer's "hot buttons." (See Exhibit III-6 for description of system benefits.)

III. **Suggested Configuration(s)**

-- Explain the advantages of the configuration(s) recommended.

-- Provide a physical floorplan, showing where the workstations and supporting network will reside.

IV. **Pricing**

-- For each configuration.

-- Compared to a non-networking alternative.

V. **References**

-- Provide testimonials and examples of uses of the STARLAN NETWORK, as appropriate.

VI. **AT&T Service and Support**

-- Summarize the service and maintenance available for the network, including available maintenance, hotlines, training classes, reference materials, etc.

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EXHIBIT III-6

AT&T STARLAN NETWORK Selling Features

- Total Data Network Solution: The STARLAN NETWORK is part of a complete data networking solution and is compatible with:

  -- Premises Distribution System (PDS): PDS provides the customer with a consistent low-cost wiring scheme that supports both voice and data communications. However, the STARLAN NETWORK is also compatible with other in-place wiring schemes and therefore does not require a premises-wide commitment to PDS.

  -- AT&T Information Systems Network (ISN): ISN provides medium and large businesses with a high speed backbone network which supports terminal-to-host and host-to-host connectivity. Multiple STARLAN NETWORKs can be linked using ISN. Additionally, workstations on STARLAN can access ISN devices or services.

  -- AT&T Information Systems Architecture (ISA): Customers are assured complete compatibility with the entire AT&T product line of voice and data services -- both today and tomorrow.

- Low Cost, High Performance Solution: The STARLAN NETWORK provides a low-cost, high-speed communications solution for intelligent workstations.

- Twisted Pair Wiring: Installation is made simple by the use of standard telephone wiring (inexpensive unshielded twisted pair) and modular, plug-in components.

  -- Use of In-place Building Wiring: The Closet Star configuration uses unused pairs in a building's phone wiring and shares common administration points with the building's phone system -- thus eliminating the installation of new wire.

- Flexible Configurations: The STARLAN NETWORK is designed for expansion. A variety of flexible, modular configurations permit easy growth and rearrangement -- and eliminate expensive software and hardware changeouts.

  -- Entry Level Daisy Chain Configuration: This configuration is right for smaller workgroups (two to ten workstations) with co-located PCs, and offers a low-cost way of getting started -- without precluding growth.

Continued on Next Page

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EXHIBIT III-6 (Continued)

AT&T STARLAN NETWORK Selling Features

- MS-DOS and UNIX on a Single Network: A single network supports both operating systems and allows customers to incorporate more powerful UNIX System-based processors as servers for their MS-DOS workstations.

- Supports a Wide Range of Workstations and Servers: The STARLAN NETWORK protects the customer's investment in equipment by supporting a wide range of workstations and servers -- including AT&T and IBM devices -- and ensures the customer of networking connectivity now and in the future.

- Supports Industry Standards: AT&T protects the customer's investment by supporting a wide range of hardware and software standards.

  -- The STARLAN NETWORK has been accepted as the IEEE draft standard for 1 Mbps CSMA/CD networks over unshielded twisted pair wiring. This ensures broad networking compatibility with existing and forthcoming products on the market.

  -- Support of software standards, including MS-DOS 3.1, Microsoft Network's Core Protocols, NETBIOS, and UNIX System V, enables customers to run standard off-the-shelf software (including applications developed for the IBM PC Network and Token Ring Network).

- Open Architecture: AT&T encourages third party development of hardware and software components that will be supported by the STARLAN NETWORK and is providing appropriate documentation and training to support these efforts.

- Support and Services: AT&T's nationwide installation and service, multiple installation options, hotline support, etc. offer customers the assurance that this product will be thoroughly supported and that their investment is safe.

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EXHIBIT III-7

Using the AT&T STARLAN NETWORK to Sell Other AT&T Products

If you have sold a STARLAN NETWORK, ask them...	In Order To Sell:
Have you considered a PC 6300 PLUS as a server for your STARLAN NETWORK? Its high-speed processor, high resolution monitor, and many extras make it an excellent alternative to the IBM AT.	PC 6300 PLUS
Did you know that you can link our AT&T UNIX PC to the STARLAN NETWORK? It's perfect for managers and professionals who want easy window/mouse operation, voice and data communications, and powerful computing capabilities.	UNIX PC
For even more powerful server capability, have you considered our UNIX System-based AT&T 3B2 processor? It offers high performance and supports up to 720 MB of hard disk storage.	3B2 Processor
Before we install the STARLAN NETWORK, have you heard about our MERLIN Communications System? For a few dollars more, we can wire you for MERLIN at the same time, so you can take advantage of its attractive voice communication features. This will eliminate disruption and additional wiring costs in the future.	MERLIN
Target these questions to corporate evaluators:	
Do your workteams need easy access to mainframe computers or high speed terminal-to-host and host-to-host connectivity? Or would you like to interconnect multiple STARLAN NETWORKs? If so, consider ISN.	ISN
Are you putting up new company locations? If so, wire with PDS and be assured that this versatile cabling scheme (fiber backbone, twisted pair distribution) will carry you into the future by supporting both voice and data products.	PDS

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We have concentrated thus far on how to create new sales opportunities for other products. The converse is also true. If you have sold other products, such as workstations, or PDS, you should also take an opportunity to introduce the STARLAN NETWORK. Exhibit III-8 provides some leading questions that will help you create opportunities to sell the STARLAN NETWORK.

J. STARLAN NETWORK Positioning

This subsection offers some guidelines on how to position the STARLAN NETWORK with internal products such as ISN, 3BNET, PC Interface and AT&T multi-user systems. It also provides information on how to position the STARLAN NETWORK against IBM's networking products.

1. AT&T STARLAN NETWORK and ISN

The AT&T STARLAN NETWORK is designed to support PC-to-PC networking. It is optimized for intelligent workstation traffic and provides application services appropriate to a PC network. As such, it should be presented as a complement to -- and not as an alternative to -- the ISN backbone network, which has been optimized for terminal-to-host and host-to-host traffic.

This is a common misunderstanding and arises out of the STARLAN NETWORK's ability to accommodate asynchronous devices including dumb terminals and (in later phases) printers, modems, etc. through its RS232 interface. Despite this capability, the STARLAN NETWORK should not be viewed or positioned as a general purpose network. This capability was provided to protect the investment of customers who might wish to continue using a small number of existing departmental terminals. Another way in which they might use the NIU is to support a laser printer in a remote room so as not to disturb workstation users.

While the STARLAN NETWORK supports multi-user processors as servers, the network, as we have stated before, has been optimized for PC-to-PC traffic. Its packet sizes (the size of the pouch carrying characters of information) are large to accommodate the traffic of intelligent workstations. During on-line transaction processing, where the devices are typically asynchronous terminals, traffic is released one character at a time. When each of these characters is inserted in a separate, large data packet, the result is increased network overhead and slower response time for the terminal user. Additionally, the processor, which must now support network and server software (as well as act as a host processor), will most probably support fewer non-intelligent devices.

The Bottom Line: The STARLAN NETWORK is not designed to be, and will not efficiently operate as, a mini-ISN. In other words, we do not recommend selling a STARLAN NETWORK that consists entirely of NIUs connecting terminal devices to a UNIX System-based host on the network. These terminals will experience some performance degradation. Be prepared for this common misunderstanding and take immediate steps to clarify the different, but complementary, roles of these two products.

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EXHIBIT III-8

Creating AT&T STARLAN NETWORK Sales Opportunities

If they have purchased:		Ask them:
1.	AT&T PC 6300 PC 6300 PLUS AT&T UNIX PCs AT&T 3B2	Did you know that our STARLAN NETWORK can tie these and other compatible workstations together, and that the network supports both UNIX and MS-DOS operating systems?
2.	AT&T 3B2	Did you know that you could also use the 3B2 Processor as a server on the STARLAN NETWORK? It can be expanded to provide up to 720 MB of shared hard disk storage for network users.
3.	MERLIN	Before we wire you for MERLIN, have you considered the STARLAN NETWORK to link your workstations? Even if you don't need it now, it only costs a little more to run an extra STARLAN NETWORK twisted-pair wire now, so you'll be able to take advantage of the STARLAN NETWORK's services whenever you're ready.
4.	PDS	Now that you've installed PDS, do you know that you are wired for the STARLAN NETWORK as well as for other voice and data products -- and can now take advantage of PC networking?
5.	ISN	Have you thought about linking your PC users with our STARLAN NETWORK? Not only does it give users PC network services, but it can link to ISN for access to mainframe computers. And, ISN can be used to interconnect multiple STARLAN NETWORKs.

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2. The STARLAN NETWORK and the AT&T 3BNET

AT&T 3BNET is an Ethernet™ compatible local area network that is used to interconnect AT&T 3B computers. 3BNET uses industry standard 10 Mbps Ethernet coaxial cable as the interconnecting physical medium. In addition to Ethernet compatibility, 3BNET provides file transfer, remote command execution, and UNIX System mail facilities for the 3B computers. Additional application requirements are supported through an application interface to the network, which allows the development of customized applications.

AT&T offers several products that use the 3BNET application interface to provide connectivity among 3B computers, PCs and mainframes. These products are:

- AT&T PC Interface: Offers a high-speed connection to PCs and 3Bs, where high volume data transfer is required.
- AT&T Communications Processor: Provides access to mainframes from 3Bs over 3BNET media.
- AT&T Enhanced TCP/IP WIN***/3B Interface: Provides connectivity to multi-vendor equipment and offers services such as remote login, file transfer, etc.

AT&T 3BNET should not be presented as a substitute for the STARLAN NETWORK. It should be presented as a network for local clustering of departmental computers. If the nature of the application is such that it requires mainly PC-to-PC communications and 1 Mbps bandwidth is sufficient, the STARLAN NETWORK should be considered. If the networking applications are such that they require high data rates, high volume data transfers, and mixed-vendor equipment connectivity, then 3BNET is clearly the choice.

3. The STARLAN NETWORK and AT&T PC Interface

PC Interface is a software product that provides MS-DOS to UNIX System V Release 2 bridging and positions the 3B2, 3B5 or 3B15 as a file server for MS-DOS workstations. As a software product, it supports two types of physical connections:

- RS232 at speeds of up 9600 baud.
- 10 Mbps Ethernet (coax).

The major differences between PC Interface and the STARLAN NETWORK are:

- The STARLAN NETWORK offers DOS-to-DOS PC networking as well as UNIX PC networking.
- The STARLAN NETWORK cabling is unshielded twisted pair and is also a fundamental component of AT&T's Premises Distribution System.

In addition to providing multiple operating system support, the STARLAN NETWORK provides and enhances the capabilities found in PC Interface while providing a low cost alternative to coax cabling.

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For customers who have applications which take advantage of (or who already have) 3BNET or Ethernet cabling, PC Interface over Ethernet is the configuration of choice. Additionally, some customers require server functionality but do not wish to upgrade UNIX System V Release 2. For those who are also attracted by the lower costs -- and lower speed -- of RS232, PC Interface running on RS232 cable is again the solution which may meet the customer's price/performance requirements.

For desktop computing which can benefit from modularity and integration into a much larger corporate network, a total AT&T solution including ISN and the STARLAN NETWORK is an attractive solution. AT&T is committed to an open system approach to networking, providing integration with other vendors' equipment and protecting customer investments. The STARLAN NETWORK and PC Interface are complementary in meeting this goal.

4. AT&T STARLAN NETWORK versus a Multi-User System

A common question that arises is when a customer should buy a network with PCs and when it is appropriate to buy a multi-user system using a central processor and less intelligent devices.

Although these systems are quite similar in capability, there are definite situations when you might want to recommend a STARLAN NETWORK versus a multi-user system, such as a 3B2 with multiple workstations attached.

One of the major criteria for recommending one or the other has nothing to do with performance or capabilities but is related to the purchasing profile of the customer. In other words, if a company understands its current needs and expects only limited growth, they may find a multi-user solution appropriate and cost-effective. On the other hand, if early on a customer does not understand the full benefits of automating, he/she may acquire two or three workstations, believing that adequate. Eventually, they may find that their system is expanding rapidly, but that the users have no way of sharing files, communicating, sharing printing resources, etc. This latter organization will find networking a good solution to the problem -- a solution that will be much the same as a multi-user system.

Some additional circumstances under which you should recommend the STARLAN NETWORK are:

- When users have mixed MS-DOS/UNIX System workstation needs.
- When applications or user preferences/profiles clearly demand personal computing power.
- When an organization anticipates moderate to extensive growth in the number of PCs or personnel but wants a low-cost start-up solution that precludes buying a large multi-user system.
- When an organization requires MS-DOS applications.

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The circumstances under which you should recommend a multi-user system are:

- When users anticipate the need for frequent and/or continuous access to corporate or centralized data.
- When users require centralized transaction processing for their application.
- When users have no commitment to MS-DOS applications.
- When there is no specific requirement for personal computing power locally.
- When an organization has a stable number of users and relatively limited plans for growth.

Users of these multi-user systems will often want to use networking as a replacement for directly connected workstations. While a small number may find this a good alternative -- providing them, for instance, with support for greater distances between the processor and terminal devices -- this approach should be carefully considered.

As stated previously, the STARLAN NETWORK has been optimized for large communication packet sizes. In cases where the STARLAN NETWORK is used to connect terminals to hosts, individual characters must be sent in large packets, thus causing increased network overhead and resulting in slower response time for the terminals. Therefore, while the STARLAN NETWORK will accommodate terminals via the NIU, we do not recommend that the STARLAN NETWORK, as currently designed, be used exclusively as a terminal-to-host network.

5. AT&T STARLAN NETWORK and Third Party Network Software

Customers, as well as vendors, have been impressed by the simplicity of the STARLAN NETWORK hardware and now perceive the STARLAN NETWORK to be the network hardware of choice. There are a number of network vendors, including Novell and 3Com, that have positioned themselves as providers of network operating systems (NOS). It is therefore not a surprise that both companies have announced the intent to port their software onto STARLAN NETWORK hardware.

AT&T is committed to encouraging the STARLAN NETWORK as a standard and is working with many hardware and software vendors to accomplish this. Specifically, we have made hardware, software, and documentation available to encourage third parties to work with us in establishing the STARLAN NETWORK as a hardware standard.

While numerous software implementations available through third parties are expected in the future, the AT&T STARLAN NETWORK software will continue to be unique in the marketplace. It is designed to be tightly integrated with ISN, supports MS-DOS and UNIX System-based workstations, and offers an attractively designed set of end-user interfaces that is consistent across the workstation product line.

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However, situations will arise where customers:

- Are expanding their network, and have a present commitment to third party NOS software. This may be due to a desire to avoid switching out an in-place end-user interface (thereby avoiding retraining), or unique characteristics of the package in question.

- Need to run a vertical application package supported only by third party NOS software.

In these situations, explain that, unlike third party software, the STARLAN NETWORK software makes use of AT&T's URP protocol necessary for interface to ISN. If the customer makes use of third party network operating software on one or more networks, those cannot be bridged via ISN to other STARLAN NETWORKs; nor can they access ISN connection services. If this constraint does not adversely impact the customer's long term goals, sell the necessary STARLAN NETWORK hardware and let the customer rely on third party software.

6. The STARLAN NETWORK versus the IBM PC Network and the Token Ring Network

IBM now has two competing solutions for networking PCs; both are departmental networks and the STARLAN NETWORK will be competing against both products in the short term. Although IBM is attempting to position these products as meeting different customer needs, it is evident that the marketability of the IBM PC Network will be negatively affected by the existence of the Token Ring. The latter is clearly IBM's mainstream solution and supports IBM's cabling scheme (which PC Network does not). For specifics of both products and how IBM has positioned them relative to each other, see the IBM Product Analyses in the Competitive Analysis section of this Marketing Guide.

As a standalone product, the STARLAN NETWORK is a highly competitive product with superior price/performance. When it is is sold in combination with PDS and ISN, it is clear that AT&T has a total solution that provides greater functionality and connectivity than the limited solution that IBM has announced.

Concentrate on the following selling features and advantages over IBM:

- The Token Ring is a limited work group solution, without generic bridging capability and without a backbone network. AT&T provides a total solution via the PDS/ISN/STARLAN NETWORK combination, providing internetworking for multiple networks, as well as the ability for workstations on a STARLAN NETWORK to access ISN services and hosts.

- Wiring simplicity is a major advantage of the STARLAN NETWORK. Although IBM has announced use of unshielded twisted pair, this implementation imposes multiple restrictions, including distance limitations, reduction in the number of closets supported, etc. For example, a distance of 990 ft. over data grade is reduced to 330 ft. over twisted pair in

a single closet configuration. In a multiple closet configuration only 150 ft. is supported over twisted pair. Additionally, media cannot be mixed on TRN lobes (between workstations and closets). The STARLAN NETWORK, on the other hand, is optimized to run on unshielded twisted pair wire and supports a distance of 800 ft. between NEU and workstation.

- The STARLAN NETWORK supports a broader range of workstations and processors, providing support for UNIX System as well as MS-DOS devices, and accommodating IBM compatibles. The Token Ring accommodates the IBM PC (PC-DOS) family only; it is yet unclear whether compatibles are supported.

- The STARLAN NETWORK's file and print server capabilities offer greater functionality than IBM's PC Network Program, particularly in the area of print queue management. (The Token Ring Network also uses the PC Network Program as its software.) Additionally, the STARLAN NETWORK has better security features.

- The availability of a daisy chain configuration (which requires no central hardware) on the STARLAN NETWORK represents a lower entry cost for small configurations. Compare the prices on a typical three PC start-up configuration (wiring not included):

AT&T STARLAN NETWORK

Daisy Chain:	$720/workstation
Star:	$915/workstation

IBM TOKEN RING NETWORK

Star:	$1060/workstation

- The STARLAN NETWORK provides for far greater configuration flexibility by supporting star and daisy chain configurations, as well as mixed configurations in which each leg of a star can support either daisy-chained or directly connected workstations. Additionally, the STARLAN NETWORK supports a two-tiered network structure for tying together multiple hubs, allows voice/data wire integration, and has the ability to be integrated with ISN.

- Server support on IBM is limited to the PC XT and AT, and a gateway provision for supporting Series/1 as a server. The STARLAN NETWORK supports a range of MS-DOS and UNIX System-based serving devices. Additionally, this integration of multiple operating systems enables us to accommodate other AT&T UNIX System processors as servers on the network.

- In addition to the UNIX PC and the 3B2, both of which can provide asynchronous ports, inexpensive asynchronous support is provided on the STARLAN NETWORK via the NIU. IBM provides asynchronous support only via a PC.

- In addition to providing programming interfaces for MS-DOS applications development, the STARLAN NETWORK also features a UNIX System program interface (TLI) for applications development.

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When selling against the STARLAN NETWORK, IBM will most likely try to imply that the Token Ring is superior in its higher data rate (4 Mbps).

This is a fallacy, however. Throughput between two devices on the network is generally far less than the advertised transmission speed, with the limiting factor being the speed of the data transfer from memory or disk on the processor, and not the speed of the media. A 1 Mbps transmission speed has been determined to be sufficient to support PC-to-PC traffic in typical office environments and therefore, response times in lightly loaded networks typical of most office environments should be similar. Because the Token Ring Network offers greater aggregate throughput than the STARLAN NETWORK, response times will differ only when the network reaches saturation.

IBM's token passing access scheme provides fairly constant throughput rates even in heavily loaded environments and is generally less sensitive to smaller packets than other access schemes. However, due to the extensive fault management techniques (such as token maintenance) that are required in a token passing (but not in CSMA/CD) environment, CSMA/CD networks typically perform better than the token ring in lightly loaded conditions.

Because the STARLAN NETWORK is so easy to reconfigure and rearrange, when saturation is reached, the customer can easily reconfigure a STARLAN NETWORK into two or three networks and then bridge the networks.

This is a capability IBM's Token Ring Network does not have. If the network reaches saturation (which happens at 72 users in an unshielded twisted pair environment) a customer can only divide the network into two. There is no way of bridging those networks currently.

From an applications software availability perspective, the STARLAN NETWORK can support applications written for the IBM PC Network and the Token Ring Network. This is accomplished by the STARLAN NETWORK's support of software standards.

In addition to MS-DOS 3.1, the STARLAN NETWORK supports NETBIOS (INT 5C) as a programming interface for developing MS-DOS network applications. This capability is supported via software included in the PC 6300 Network Program and is provided to ensure compatibility with applications written to the IBM PC Network (and Token Ring Network) NETBIOS.

K. Selling Scenarios

Described below are two typical STARLAN NETWORK sales opportunities. The first example relates to small business sales; the second, to large business sales. Both demonstrate how the selling approach described above can successfully be applied in customer situations.

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Situation #1: Small Magazine Firm

Source of Lead: Present PC 6300 Customer.

Requirements/Concerns:

- Owner seeks to buy personal computers for an eight-person editorial staff.
- Needs centralized document storage, and on-screen editing of articles.
- Needs to maintain and print a 20,000-subscriber mailing list.
- Most employees have little or no computer experience.
- Up to five people will work on the network at one time. Users will work in one room.
- Service and support are of great concern to the owner.

Key Selling Points:

The following are the most important selling points to present in this situation:

- Easy, Low-Cost Startup. The STARLAN NETWORK costs less than other leading PC networks. The Daisy Chain configuration provides low-cost networking for two to ten workstations.
- Supports both the AT&T PC 6300 and the IBM PC. Unlike other PC networks, the AT&T STARLAN NETWORK supports a variety of MS-DOS-compatible personal computers.
- Easy Expansion. No component swapouts are required. The STARLAN NETWORK can expand to meet almost any future requirement.
- Full Service and AT&T Support. Reliable service, hotline support, and training programs are all available from one vendor -- AT&T.
- Simple Menu-Based Interface. This provides easy operation, even for first-time users.

Situation #2: Major Money Center Bank

Source of Lead: Major System 75 Customer.

This customer has two groups interested in the STARLAN NETWORK. The MIS Department is evaluating PC networking systems, and an end-user group will use the system during the test.

Situation #2A: MIS Department

Requirements/Concerns:

- The PC LAN must fit into the bank's overall networking strategy -- providing facility-wide connectivity.
- The bank seeks a viable, long-term standard.
- Low-cost physical distribution. Since users move frequently within the facility, easy reconfiguration is required.
- Must support any of the bank's 8,000 PCs, which include IBM PCs, IBM ATs, COMPAQs, and COMPAQ Deskpro™ 286s.

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- Must link workteams located in different areas of the bank into a common network.

- Must provide PC users with access to mainframe data bases.

Key Selling Points:

The following are the most important selling points to present to the MIS Department in this situation:

- The AT&T Total Solution -- ISN, PDS, and the STARLAN NETWORK. AT&T offers a complete solution: a consistent, low-cost wiring scheme; STARLAN NETWORK bridging; and PC access to ISN services.

- Twisted-Pair Wiring Plan. Twisted-pair wiring provides low-cost connections to individual workstations.

- Connectivity. Supports the IBM PC, XT and AT, as well as the AT&T PC 6300 and PC 6300 PLUS.

- An Industry Standard. The STARLAN NETWORK has been adopted as the IEEE standard for one-Mbps CSMA/CD networking over unshielded twisted pair.

Situation #2B: End-user group

Requirements/Concerns:

- A large customer database, developed by using Informix™, is now too big for the department's IBM AT. Each manager needs occasional access to this information.

- The department spends thousands of dollars for individual copies of application software, such as Lotus 1-2-3.

- Users need to share files and templates using such applications as MultiMate™, Harvard Project Manager™, and Lotus 1-2-3.

- The department has one laser printer that it would like users to share.

- The group will want to communicate and share information with other organizations throughout the building and campus.

Key Selling Points

The following are the most important selling points to present to the end-user workteam in this situation:

- Supports Powerful UNIX System-Based Servers. The Informix data base can be installed on a 3B2. Users can access the system from their MS-DOS PCs. Also, the 3B2 can provide services for horizontal applications like Lotus 1-2-3.

- Extensive Resource Sharing. The workteam can share the laser printer for increased productivity.

- Easy Reconfiguration to Support Frequent Relocations. The network configurations are easy to expand and rearrange using twisted-pair wiring. Adding workstations does not make existing equipment obsolete.

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- Mainframe Connectivity Via ISN, or Via 3270 Terminal Emulation on a 3B2. Users have access to mainframe data bases through their desktop PCs.

- ISN Bridging. ISN can provide bridging between this workgroup and other groups using STARLAN NETWORKS elsewhere in the building or on the campus.

L. Responding to Customer Questions

Here are some common questions asked by customers, and some suggested responses.

1. Performance and Design-Related Questions

Question 1: What is the STARLAN NETWORK's throughput relative to other PC networks?

- STARLAN NETWORK performance, as measured by running PC Magazine benchmarks, compares favorably with other PC networks, including those which run at 2 Mbps and 10 Mbps (e.g., IBM PC Network and Ethernet-based networks).

Question 2: Since higher bandwidths generally provide greater aggregate throughput, why did you choose to provide a 1 Mbps data rate rather than going with higher speeds?

- There are a variety of reasons for the selection of 1 Mbps, including:

  -- As indicated previously, 1 Mbps has been determined to be a sufficient speed for PC-to-PC traffic.

  -- A primary design objective was the ability to run on inexpensive building wire -- standard unshielded twisted pair -- so as to accommodate the wiring installed in most customer sites.

  -- Another important objective was the ability to meet customer distance requirements (see Question #3 below).

  -- Yet another objective was to implement a solution that does not require custom devices and uses standard commercial parts.

Question 3: Is the 800 ft. serving radius a significant restriction?

- This is not a significant restriction at all. AT&T studies have shown that 95% of workstations are located within 200 ft. of the local telephone wiring closet (where NEUs are typically installed). Approximately 99% of workstations are within 800 ft. of the closet. Therefore, the STARLAN NETWORK is capable of supporting the vast majority of installations.

Question 4: How reliable is the STARLAN NETWORK running over unshielded twisted pair?

- Published IEEE specifications indicate that the STARLAN NETWORK will run reliably at proposed distances over unshielded twisted pair. Note that Bell Laboratories (ISL) has a long standing reputation for developing reliable products and being conservative in its published specifications.

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Question 5: Would the use of shielded cable improve the distance capabilities of the network?

- Nothing in the STARLAN NETWORK design prohibits its use over shielded twisted pair. We have not tested it on such wire nor published statistics on its distance limitations in such an environment. Per Question #3 above, our studies show that support of greater distances is not generally a requirement for single closet services. If greater distances are required, ISN can be used.

Question 6: With the currently-announced product, a multi-hub (two-tier NEU) configuration requires that the NEUs be co-located. Does that mean the STARLAN NETWORK does not support multiple closets?

- As announced, this product requires co-located hubs and is restricted to a single closet. However, a repeater has been developed and is under test, and will become available later this year. The repeater will support a five-tier network with an unlimited number of closets and extend the closet serving radius to 4000 ft.

Question 7: How does the STARLAN NETWORK provide SNA™ support?

- SNA support is currently provided via the AT&T 3B2 Processor. However, it is important to understand that this device is not intended to replace a cluster controller.

Question 8: Is the PC 6300 Hard Disk machine an appropriate server for most network configurations?

- The PC 6300 HD, as well as the PC 6300 PLUS, are superior alternatives to the IBM PC XT and AT, which are typically used as servers by IBM and competitive vendors. However, the size of the network and the amount of hard disk storage required will determine whether the PC 6300 HD is appropriate in a given configuration. There is no restriction on the number of servers, so additional storage can be provided through the use of multiple servers. Additionally, AT&T supports higher-functionality servers including the UNIX PC and the 3B2 Processor.

Question 9: How do voice phone sets, both digital and analog, connect to the STARLAN NETWORK?

- Analog phone sets may be connected through the "phone" jack on the NAU. Voice and data signals travel over a four-pair modular cord and in-place building wire (behind the wall) to the phone closet, where they are split off. Voice traffic goes to the PBX and data traffic to the NEU. Digital sets require extra wire pairs and thus do not leave enough pairs (2 pairs) for STARLAN NETWORK traffic. Therefore, digital sets and network workstations must connect to separate jacks. PDS has provided a standard two-jack solution to accommodate such situations.

Question 10: Will the STARLAN NETWORK support any other non-IBM compatible computers, such as Apple devices?

- AT&T provides an open architecture and encourages widespread connectivity with our products. We

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are working with select companies, such as Quotron, to achieve this. However, we do not have the internal development resources to accommodate the many diverse products on the market today. Therefore, we have embarked on an aggressive program to provide appropriate documentation and training that will enable other vendors and third parties to develop interfaces to the STARLAN NETWORK for a variety of products.

2. Software-Related Questions

Question 1: What applications have been tested to work on the STARLAN NETWORK?

- Due to our support of MS-DOS 3.1 and NETBIOS, most applications written for the IBM PC Network and the Token Ring Network are compatible with the STARLAN NETWORK. In addition, we have tested a variety of best-selling packages to ensure their compatibility. Testing will continue on these and other software products; documentation at the time of product availability will provide guidance on how to install these applications to ensure that no problems are encountered. A preliminary list is provided at the end of the Product Description (Section V).

Question 2: What boards have been tested on PCs running the STARLAN NETWORK Program to identify whether there are any compatibility issues to be resolved?

- The STARLAN NETWORK development organizations have tested a variety of boards for compatibility. A complete list of boards tested and associated documentation will be issued at time of product availability. A preliminary list is provided at the end of the Product Description (Section V).

Question 3: Will any other network operating systems, such as Novell's NetWare™ or 3Com's 3+™, be able to run on STARLAN NETWORK hardware?

- Both companies have announced their intention to port their software onto STARLAN NETWORK hardware.

  As you know, there are a number of network vendors, including Novell and 3Com, that have positioned themselves as software providers. Many software vendors perceive the STARLAN NETWORK to be the network hardware of choice.

  AT&T is committed to encouraging the STARLAN NETWORK as a hardware standard and is working with many hardware and software vendors to accomplish this. We have made hardware, software, and documentation available to encourage third parties to work with us.

  While we expect that there will be numerous software implementations available through third parties in the future, the AT&T STARLAN NETWORK software will continue to be unique in the marketplace. It is designed to be tightly integrated with ISN, supports both MS-DOS and UNIX System workstations, and offers an attractively-designed set of end user interfaces that is consistent across the workstation product line.

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Question 4: When will terminal emulation be available?

- Terminal emulation will be supported at the time of initial delivery. Standard AT&T terminal emulators for the PC 6300 and UNIX PC are compatible with the STARLAN NETWORK Program. These emulators are optional packages and must be installed on each workstation that will use them.

Question 5: Does the AT&T STARLAN NETWORK provide for both electronic mail and real time messaging in the MS-DOS environment?

- Customer feedback has indicated that electronic mail is an essential service for PC networks. Real time messaging, on the other hand, is perceived as having limited value, especially if the electronic mail package has provisions for urgent delivery. In response to this customer input, our initial release will support an optional electronic mail package for the MS-DOS environment. (This was not indicated at time of the original STARLAN NETWORK announcement.) Electronic mail is provided on the UNIX System as a standard feature.

Question 6: Is file sharing supported in a UNIX System only environment?

- The first release of 3B2 networking will provide file sharing. File sharing between UNIX PCs will be available later with an enhancement of UNIX System V. File transfer (as opposed to sharing) is supported by the initial release of all STARLAN NETWORK UNIX System products.

Question 7: Who developed software for the STARLAN NETWORK?

- Software is being provided by a combination of sources, both internal and external. AT&T is supplying the basic communication software and is working with third parties to provide application-level software. When outside resources are involved, the product is unique to AT&T in that it meets AT&T specifications and does not reflect a direct port of any existing software product on the market.

3. Internetworking-Related Questions

Question 1: Why did you choose to use URP, a proprietary protocol?

- URP provides the ability to efficiently interconnect with ISN. Although URP is a proprietary protocol, AT&T has made interface specifications available to other vendors and therefore we do not consider this to be a closed system.

Question 2: Do you intend to provide any alternatives to ISN for bridging multiple STARLAN NETWORKs?

- ISN is currently the only vehicle for connecting multiple STARLAN NETWORKs. However, there may be customers with small configurations or with basic networking needs for whom ISN is not a cost-effective option, but who still need to bridge PC networks. For these customers, we are committed to providing appropriate solutions.

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4. Future Directions

Question 1: Can you provide insight into future enhancement programs and product directions?

- Without preannouncing specific products and capabilities, we would like to provide some insight into major product trends that will be addressed by future STARLAN NETWORK enhancements:
  - -- SNA support (including LU 6.2/APPC).
  - -- Closer integration with our voice products.
  - -- Centralized management and administration facilities.
  - -- Increased internetworking capabilities via gateways and bridges.

Question 2: Trade journals have indicated that AT&T might provide a cost-reduced version of the STARLAN NETWORK using the Intel 82588 chip. Is this expected any time in the near future?

- Our current product uses the Intel 82586 chip in its design. This chip was selected because development began before the Intel 82588 chip was available. Changing the design direction in mid-stream would have impacted product delivery schedules. However, nothing in the current implementation prevents us from using the 82588 in the future.

Question 3: One trade journal quotes an AT&T source as saying that AT&T is working on a 5 Mbps version of the STARLAN NETWORK. Is this true and if it is should my customer wait?

- AT&T has not announced such a product. It is our position that a 1 Mbps network meets the needs of most office applications today. Additionally, AT&T has provided a flexible way to break up and reconfigure the STARLAN NETWORK as it grows and becomes saturated. We also can bridge these smaller networks via ISN. Most competitors do not have this flexibility. Therefore, most customers have no reason to invest in higher bandwidth alternatives.

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IV. COMPETITIVE ANALYSIS

This section provides an overview of key PC networking vendors and their products, including selling features, strengths, weaknesses and selling strategies.

The main PC networking competitors and their products are:

- Primary Competitor:
  - -- IBM:
    IBM PC Network and
    IBM Token Ring Network
- Secondary Competitors:
  - -- 3Com:
    EtherSeries™ 2.4 and
    3+ Network
  - -- Novell:
    Netware™/68 with Netware/S
    and Netware/*
- Others:
  - -- AST: PCnet II™
  - -- Corvus: Omninet™
  - -- Fox: 10-Net™
  - -- Nestar: Plan 4000™
  - -- Orchid: PCNET
  - -- U-B: Net/One™ and Personal Connection/OpenNet™

In-depth analyses of some of these vendors/products follow. These products have been chosen because they are the most likely to be competing against the AT&T STARLAN NETWORK.

The format of these analyses is as follows:

- General Vendor Overview
  - -- Company Overview
  - -- Product Line Overview
  - -- Sales and Support Profile
  - -- Target Market
- Product Analysis
  - -- Network at a Glance
  - -- Hardware/Software Components & Installation
  - -- Strengths & Weaknesses
  - -- Ease of Operation
  - -- Documentation
  - -- System Management Experience Required

Every attempt has been made to provide you with current competitive information. However, in this highly fluid market, products continually change and/or are enhanced. Most changes will be at the software, as opposed to the hardware, level.

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3COM CORPORATION

A. Company Overview

3Com Corporation is one of the most successful LAN vendors in the market. It was the leader in shipment share in 1984 and has an installed base of some 120,000 nodes (over 10,000 systems). It is a company with solid product and a good image.

It is apparent that 3Com is heading in a new strategic direction -- that of software provider. It has announced that it will be porting the latest announced version of its native LAN software (3+ Network) to a number of hardware solutions, including IBM's Token Ring Network and AT&T's STARLAN NETWORK.

1. Product Line Overview

3Com's software product line is undergoing a transition, with the 3+ Network replacing the EtherSeries™ software. EtherSeries and 3+ are software products. Both packages continue to run on EtherLink™, 3Com's Ethernet-based networking hardware. 3Com has been careful to accommodate its large base of existing users by providing a migration path from EtherSeries to 3+. Although EtherSeries may soon be replaced with 3+, it is discussed below to provide an understanding of the relationship between the two products:

- EtherSeries: The latest version of this package is 2.4. It represents 3Com's basic product and although it is being replaced, its functionality is incorporated into the new product.
- 3+ Network: This product became available in late January 1986. It is a replacement package for EtherSeries 2.4 and represents a superset of that package. It uses EtherLink and EtherLink+ hardware. Among the major enhancements are the incorporation of MS-DOS 3.1 and Microsoft Redirector standards, compatibility with programs developed for the IBM PC Network and the Token Ring Network, a network resource browsing facility, network bridging, and remote access.

2. Sales and Support

3Com generally sells through full-service retailers, such as Entre and Businessland. These retailers understand system selling, specialize in multi-user systems, and are prepared to offer a full line of training, configuration and consultant services. 3Com also sells to PC manufacturers for resale to end users.

To support these retailers and resellers, 3Com has developed solid sales/marketing training and a full line of support documentation and selling tools, including slide presentations, demonstrations and configuration guides. Its management is keenly aware of how to position its product and does a good job of marketing.

3Com provides a hotline for technical support, but overall it is not a large enough company to provide extensive support. It relies on its VARs/VADs and retailers to support individual accounts.

3. Target Market

3Com has positioned the EtherSeries and 3+ as products for work-group computing in small and medium-sized busi-

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3COM CORPORATION

nesses. In light of its internetworking and remote access capabilities, and its intent to port software to different hardware solutions, 3Com will continue to have some success in large corporate environments by providing interconnection among work groups at the departmental and corporate level.

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B. Product Analysis: 3+ Network/ Etherlink

Network At A Glance

Network Type:	Baseband
Data Rate:	10 Mbps
Media:	Thin/Thick Coax
Access Method:	CSMA/CD
Topology:	Bus
No. of Devices:	100/Cable Segment
Max. Distance:	Thin coax: 1000 ft. Thick coax: 3280 ft. Repeaters to join cable segments
Server Type:	3Server™ PC with hard disk (IBM XT, AT)
Devices Supported:	IBM PC, XT, AT AT&T 6300 Ericsson HP 150 Macintosh™ TI Professional Zenith
Services:	Disk Sharing File Sharing Electronic Mail Print Spooling Remote Access Bridging Backup (3Server)
Gateways:	SNA

1. Hardware Components and Installation

Basic 3Com hardware installs easily. Good documentation and illustrations are provided. Installers must be careful, however, in configuring systems. Different distances are accommodated depending on the type of coax used (thick or thin). Thick coax can go up to 3280 ft.; segments using thin coax can run up to 1000 ft., with 3 ft. minimum length between nodes. Mixed vendor systems are supported (non-3Com transceivers) but minimum distances between segments in such systems are 8.2 ft. Although repeaters can be used, one must be careful that the path between any two PCs does not have more than two repeaters.

An optional chip is available for the EtherLink card (EtherStart™), which allows users to boot directly from the network server. This eliminates the need for floppy drives in the workstations.

3Com has also recently introduced the EtherLink+ board, which improves performance.

3Com supports two types of servers: their high performance 3Server and a general purpose PC equipped with hard disk. The 3Server must be used in dedicated mode only; the PC can run in either dedicated or concurrent mode. The 3Server comes equipped with 512K, expandable to 896K. Standard disk is 36Mb, expandable to 252Mb.

2. Software Components and Installation

Software installation is relatively simple. Documentation, although the best in the industry, is sometimes misleading.

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Users should thoroughly familiarize themselves with installation procedures before installation.

The main packages available on the 3+ product are:

- 3+Share: File sharing, print spooling and naming service.
- 3+Remote: Dial-in access to network via modem for remote access.
- 3+Backup: Tape backup and restore for one or multiple 3Servers.
- 3+Menus: Full screen menu interface with windows.
- 3+3270: 3278/3279 terminal emulation.
- 3+Mail: Electronic mail.
- 3+Path: Migration path from the EtherSeries to 3+, providing resource and information sharing between the two.

3. Strengths

+ Approximately 95% of 3Com installations use thin coaxial cable, which significantly lowers wiring costs. Thick coax costs $7/meter; thin coax runs $1.50/meter.
+ The availability of a high performance server with extended disk capacity (up to 252 Mb of storage) is an asset. Additionally, this network allows general purpose PCs to act as dedicated or concurrent servers. Published information indicates that the 3Server can accommodate 15 users for transaction applications, and 50 users for productivity applications.
+ 3Com has incorporated file caching, elevator seeking, and memory resident directories into its file server. This should help its performance.
+ Announced support of MS-DOS 3.1 and Microsoft core protocols permits compatibility with applications written for the IBM PC Network and Token Ring Network.
+ The network browsing facility is an excellent feature. Additionally, permanent unique names for network users are available, increasing security and providing extensive network management. Network access from any workstation via a "username" is an attractive feature.
+ Remote access permits access of network from remote location.
+ The 3Com mail package has won awards for convenience, robustness and ease of use. 3+Mail provides intra- and inter-network communication.
+ Ability to bridge multiple networks is an important enhancement.
+ 3Com sports a reputation as a vendor with an easy-to-use product.

4. Weaknesses

- Despite a high functionality server and a 10 Mbps data rate, 3Com's performance in the past has only been average. It will be interesting to note how it performs with the new software. Additionally, the new

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EtherLink+ board should improve performance.

- Configuration of the system still has pitfalls, due to the coaxial nature of the system, the different minimum/maximum restrictions on distance imposed by the media, and the unique problems associated with repeaters.

- Software pricing is server based and thus is expensive for very small configurations.

5. Ease of Operation

3Com's EtherSeries has been evaluated as one of the best documented and simplest to operate PC networks. The menu is helpful, providing applications and network features access. Changes to the menu will be made to accommodate the new capabilities, and will most certainly represent enhancements.

6. Documentation

Overall, 3Com's documentation is well done. One particularly commendable feature is the use of practical examples to illustrate specific points. Although confusing in spots, it has been lauded as among the clearest in the industry. Its "Joy of Networking" volume is excellent, providing users with a detailed list of supported applications and procedures on how to install those that could cause difficulties. Despite anticipated changes to support their new software it is certain that documentation will reflect 3Com's past success in this area.

7. System Management Experience Required

System management experience, though helpful, is not a requirement, since 3Com's system is one of the easiest in the market to install, configure and manage. It is made easier by 3Com's "Joy of Networking" publication, which guides managers in the installation and nuances of applications software and explains problems that may be encountered with individual software packages.

8. Remarks

Software pricing is server-based and is determined by how many users there are. There are two pricing structures: one for five users or under and another for an unlimited number of users.

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CORVUS SYSTEMS, INC.

A. Company Overview

By virtue of its early entry into this marketplace, Corvus has the largest installed base of PC networks. It has differentiated itself by using twisted pair wiring and by supporting more workstations (and operating systems) than any other LAN vendor. The large installed base provides Corvus with some ability to easily expand its systems through add-on sales.

Despite its large installed base, Corvus' shipments are dropping rapidly. Its competitive edge will dissipate unless Corvus steps up its efforts to develop easier, more functional software. As a result of its recent acquisition of Applied Intelligence, a network operating system developer, improved performance and new product announcements can be expected.

1. Product Line Overview

The main products that Corvus sells are:

- Omninet™: This product interconnects a variety of workstations, and uses proprietary Corvus Servers, as well as a proprietary protocol. Record and file locking are not available. File sharing is accomplished via semaphores rather than through true locking. Limited file management is provided on Omninet via Constellation II™, a software package that facilitates file sharing by providing permissions and semaphores.
- Omnishare™: This Omninet product enables IBM XTs and ATs to act as servers. Corvus proprietary servers can be mixed with IBM servers on Omnishare. Except for the type of servers used, the hardware is identical to Omninet.
- Omninet/MS-Net: Corvus has recently announced its intent to support MS-NET on the Omninet product. This product would provide true record and file locking, a capability not formerly available on Corvus' standard product.

2. Sales and Support

Products are marketed through some 30 OEMs and 1000 dealers worldwide. Corvus also has an established technical support team. There are nearly 200 authorized Corvus Service Centers. Corvus provides training classes for OEMs and major accounts.

3. Target Market

Corvus has generally targeted educational institutions and smaller companies. Because its products represent work group solutions and do not provide a backbone network capability, Corvus has not been seriously considered by larger companies. However, some departments of large companies have acquired Omninet to solve a specific problem or meet a particular need.

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CORVUS SYSTEMS, INC.

B. Product Analysis: Omninet

Network At A Glance

Network Type:	Baseband
Data Rate:	1 Mbps
Media:	Twisted Pair
Access Method:	CSMA/PA
Topology:	Bus
No. of Devices:	64
Max. Distance:	1000 ft. 4000 ft. via repeaters
Server Type:	Proprietary/Dedicated IBM XT/AT
Devices Supported:	IBM PC, XT, AT, Jr. Compatibles Apple II Plus, IIe, III™ Apple Macintosh Corvus Concept™ DEC Rainbow 100™ TI Professional Zenith 100/150
Services:	Disk Sharing File Sharing (limited) Electronic Mail Chat/Messaging Print Spooling Backup
Gateways:	SNA Ethernet (future) X.25 (future)

1. Hardware Components and Installation

The installation of the hardware consists of board, twisted pair wire (shielded or unshielded) and tap box installation. In addition to the network hardware, Corvus provides a variety of low cost off-the-shelf "plug-in" servers -- so called because each server is already equipped with the appropriate network hardware and is directly attachable to the network. These servers tend to be dedicated to single functions, i.e. file servers cannot act as print servers, etc. Due to their low cost, this is not a problem. Additionally, Omnishare permits Corvus users to use IBM XTs/ATs as servers and to mix them on the same network with proprietary servers.

The network is fairly easy to install. There are transceiver boxes that connect the workstations to the main RS422 twisted pair bus cable. Dip switch settings have to be made and unique addresses established.

Although the distance limitations are 1000 ft., up to 4000 ft. can be accommodated using repeaters.

2. Software Components and Installation

The software installation is a slow and convoluted process. Several programs are required to accomplish certain functions.

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CORVUS SYSTEMS, INC.

3. Strengths

+ A main strength has been the early ability to support inexpensive twisted pair wiring when most PC LAN vendors were requiring the use of coax cable.

+ The number of PCs (and operating systems) supported has been a strong advantage, especially in educational institutions where Apples and other low cost PCs proliferate.

+ The large number of low cost dedicated servers has permitted customers to buy only the functionality they need. The Corvus Bank™, for instance, provides up to 200 MB on a tape cartridge and does not rely on a PC. Corvus also provides print servers, gateway servers, and a variety of disk servers.

+ Corvus stresses bridging to other systems. As a result, numerous gateways have been developed, including an SNA gateway.

+ Corvus provides an interesting start-up package for new LAN users -- with preconfigured software and hardware for a small number of users.

4. Weaknesses

- Omninet uses a CSMA/PA (positive acknowledgement) protocol. This access method causes slow response. Corvus recently upgraded its transporter card to improve performance. Nevertheless, the system still tends to be sluggish.

- The operating system does not support true file sharing and has poor file security. Omninet really only provides "disk" sharing. If a customer uses Constellation II software, some volume management functions (password and permission assignments, file sharing via semaphores, etc.) are provided, but this is still a very limited capability and not appropriate for multi-user data base environments. Semaphores notify the user that the file is being used by someone else but do not actually protect the file from being accessed by a second user. Another solution is the use of MS-NET which, although limited, provides better file sharing than Omninet's proprietary software.

- Omninet does not provide a true electronic mail function with a mail waiting indicator. Instead, it uses a file transfer operation to a shared disk.

5. Ease of Operation

Omninet is not as easy to use as its literature portrays. It would appear that the network should be simple to use because it does not provide a great deal of complexity or an extended feature set. Instead, operations become convoluted because of these system limitations.

6. Documentation

Documentation is complete and clearly written.

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CORVUS SYSTEMS, INC.

7. System Management Experience Required

As with most networks, someone with good system management experience would be desirable for this network. Some of the utilities are powerful, but difficult to use. Trouble-shooting problems could frustrate the novice since the documentation lacks trouble-shooting guidelines. Corvus does not appear to be addressing this deficiency.

8. Remarks

Novell provides a version of Advanced Netware that runs well on Omninet.

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FOX RESEARCH, INC.

A. Company Overview

Fox Research announced its product in late 1984 and, despite its small size, is expected to have a 3% share of shipments by end of 1985. The company was formed (by ComGen) to develop and market database management software. It has differentiated its product, called 10-Net™, by:

1) Using twisted pair wiring as its medium.

2) Being among the first to offer a true file server architecture designed to support multi-user applications.

3) Developing and selling the network with a data base application called 10-Base™.

4) Providing an audit trail facility that provides system usage reporting.

1. Product Line Overview

The company started by marketing 10-Base, a relational database management software package. With the announcement of 10-Net, it offered a complete networking solution that includes plug-in circuit cards, networking software, and a networked version of its 10-Base package.

2. Sales and Support

Fox Research's product is marketed through an international network of authorized distributors and dealers. Olivetti has had great success selling 10-Net in the European market.

A small company, Fox simply does not have the resources to provide adequate support services or to be responsive to user requests. Training is available by special request and at negotiated prices, depending on the type of training required and the size of the class.

3. Target Market

Due to the small number of workstations the network can support, Fox has targeted small to medium sized companies with IBM PC only environments for this product. It has also been successful in the European market, where Olivetti is its major reseller.

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FOX RESEARCH, INC.

B. Product Analysis: 10-Net

Network At A Glance

Network Type:	Baseband
Data Rate:	1 Mbps
Media:	Twisted Pair
Access Method:	CSMA/CA
Topology:	Bus
No. of Devices:	32
Max. Distance:	2000 ft. 1 mile with repeaters
Server Type:	IBM PC XT
Devices Supported:	IBM PC, XT, AT
Services:	Disk Sharing File Sharing Electronic Mail Print Spooling Remote Access
Gateways:	SNA Ethernet

1. Hardware Components and Installation

The 10-Net hardware is relatively simple to install. It uses simple twisted pair wiring as the transmission medium and uses tap boxes as interfaces to attach to the wiring. No modular jacks are used. Splicing of the twisted pair is required. The hardware also requires the installation of a terminating resistor inside each of the tap boxes at both ends of the network.

2. Software Components and Installation

Software installation requires the use of three programs in the default setup mode. A batch file has been provided to facilitate this process although the syntax for inputting the required parameters is somewhat unwieldy. In the interactive mode, a more helpful interface prompts the users.

3. Strengths

+ Fox has chosen to differentiate itself on a number of key issues, including twisted pair wiring and the availability of a networked database package.

+ 10-Base is an excellent database package. The software resides on a "superstation" and is based on SQL, an IBM database language. It uses an English-like query format and has a modifiable help facility that allows users to define commands in their own terminology. The package requires DOS 2.0 and 192K of RAM on the superstation.

+ A Forms Manager is part of the software and provides an excellent tool for productivity workers who need to format their reports in a specific way. This user-friendly facility uses screen painting, with SQL commands automatically embedded.

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FOX RESEARCH, INC.

+ A chat messaging facility, if refined, can be an excellent tool. Some commands can be executed while in the chat mode. A CB utility permits multiple users to communicate simultaneously, much like a CB radio session.

+ The audit trail is a differentiating feature. A UNIX-like "Who" command provides a listing of all users currently signed on to the network along with other user data.

4. Weaknesses

- Installers must splice wire, accommodate tap boxes, and be conscious of installing terminating resistors at each end of the network (this is even more complicated if repeaters are used).

- The fragile, unforgiving nature of the software is 10-Net's biggest liability.

- Security features are limited. Only files residing in the hard disk's root directory can be secured. Additionally, these files can only be secured from the file server by running the 10-Net security program (NETSU).

- The company is simply too small to provide adequate service, support and training.

5. Ease of Operation

Ease of use is fair at best. The network is unforgiving in command syntax and frequently requires the rebooting of stations from scratch if the wrong keystroke is made. Its menus are confusing, with complex terminology.

6. Documentation

Documentation is sparse and poorly written, although graphic representations of command keystrokes are presented in a friendly manner and leave little margin for error. By Fox' own admission, some of the language in the documentation is inordinately complex.

7. System Management Experience Required

A moderate amount of system management experience is desirable; the network is portrayed as requiring minimal experience. The software has idiosyncracies and tends to crash if procedures are not followed strictly. Some amount of system management experience makes troubleshooting and rebooting the network more tolerable.

8. Remarks

The 10-Net product requires more development in order to be considered a standout in the LAN arena. If it is to be successful in larger companies, it needs to concentrate on developing gateways and bridges. Fox has the potential to become a strong competitor if it concentrates on developing SNA support.

Fox would achieve greater acceptance if it could modify 10-Base to run on other networks.

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A. Company Overview

When IBM announced the IBM PC Network in August 1984, it legitimized the PC LAN market and brought about a doubling of micronetwork sales. Since its availability (April 1985), it has caused a major redistribution of market shares. Based on early shipment trends, consultants believe that the IBM PC Network™ will account for fully 17% of units shipped in 1985.

However, this flurry of IBM PC Network sales is about to come to an end. In November 1985 IBM announced the 4 Mbps IBM Token Ring Network™. This is a departmental (or work group) system and not the long-awaited 16 Mbps token ring backbone network previewed two years ago. As a result, IBM still does not have its total networking solution in place.

Although the two networks use different hardware components, software consists of common elements: NETBIOS (formerly packaged on firmware and now on a software diskette) and IBM PC Network Software. Therefore, software developers will most probably speed up the development of networked applications conforming to these standards.

1. Product Line Overview

Having its two major competing departmental LAN products use common software elements enables IBM to provide some continuity for its customers. Nevertheless these products use two distinct incompatible hardware solutions that involve entirely different PC adapter cards, new hubs, and support of new and different cable.

- IBM PC Network: Based on Sytek hardware, this network, which was first delivered in April 1985, is a 2 Mbps CSMA/CD LAN running on broadband coaxial cable, and is designed to interconnect small groups of up to 72 users.

  The IBM PC Network has moved all major PC LAN vendors toward support of NETBIOS and MS-DOS 3.1.

  The lower five layers of the ISO Reference Model, including NETBIOS, are implemented on the network adapter. At the upper layers, IBM implemented the Microsoft Redirector but developed its own server software.

- IBM Token Ring Network: IBM has announced 1Q86 availability for this departmental LAN which uses the token passing access scheme. IBM's Token Ring Network uses different hardware but retains the same software as the IBM PC Network.

  With this product, IBM has reversed its former position that shielded cable is necessary for data communications. It has announced that its corporate cabling scheme will support twisted pair wiring. The Token Ring Network will run on coaxial cable, shielded and unshielded twisted pair.

There is a very limited migration path from the PC Network to the Token Ring Network for customers who have implemented the older IBM solution.

Several groups within AT&T have published and distributed detailed analyses of the IBM Token Ring Network, especially with respect to ISN and the

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combination of ISN/PDS/STARLAN NETWORK. These provide excellent resource materials and we encourage you to make use of them. We specifically refer you to the Technical Analysis of IBM Token Ring and related Q&A, issued to the field December 1985 by LBS Marketing.

The analyses on the following pages concentrate on the relationship of the Token Ring network to the STARLAN NETWORK.

2. Sales and Support

The IBM PC Network was marketed through authorized distributors as well as IBM's direct sales force. Marketing by the direct sales force was halfhearted -- a definite signal that IBM did not consider it a mainstream product (subsequently evidenced by the Token Ring announcement so soon after initial availability of the PC Network product).

Even prior to the availability of the PC Network, IBM invested significant resources to court ISVs and to educate them on how to develop software (networked applications) for the PC Network. This included two-day seminars, in which key developers of the product provided Q&A support. Detailed technical documentation was also made available. Since the Token Ring Network uses the same software and will support most of these applications, this investment on the part of IBM is certain to pay off.

Although the product is not yet available, all of IBM's resources are now focused on making Token Ring Network sales to major accounts.

Service and support have always been key differentiating factors for IBM's products and this is certain to continue. In addition to installation services, IBM also provides names of independent companies that can offer design and/or installation services for their cabling/networking system.

3. Target Market

IBM has tried to position these competing networks as networks that meet differing customer needs:

IBM PC Network

- Interconnection for IBM PCs only.
- Where 2 Mbps data rate is adequate.
- Where broadband is required.
- Where single application interface (NETBIOS) is adequate.
- Up to 72 devices.
- Departmental, work group or small company solution.
- Low cost, easy entry solution.

Token Ring Network

- Interconnection for IBM PCs and departmental systems or hosts.
- Where more than 2 Mbps is a requirement.
- Where baseband is required/exists.

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- Where multiple application interfaces are required (NETBIOS SNA LU 6.2 -- APPC/PC).
- Up to 260 devices/ring.
- Establishment-wide solution for large companies with multiple work groups.

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B. Product Analysis: IBM PC Network

Network At A Glance

Network Type:	Broadband
Data Rate:	2 Mbps
Media:	Coax
Access Method:	CSMA/CD
Topology:	Hierarchical Star
No. of Devices:	72
Max. Distance:	200 ft. from hub to workstation 1000 ft. via Distance Kits
Server Type:	IBM XT, AT Series/1
Devices Supported:	IBM PC, XT, AT Portables
Services:	Disk Sharing File Sharing Messaging Print Spooling Electronic Mail*
Gateways:	SNA Asynch S/1 Gateway PC Network Gateway

* Via 3rd Party.

1. Hardware Components and Installation

The main hardware components are the PC Network Adapter, the Translator Unit, and Network Cabling.

The adapter card, which was developed by Sytek, is packaged with a 9 ft. cable and can be used in any expansion slot except #8 on the PC XT. The adapter card incorporates the lower five layers of the ISO model; NETBIOS resides in firmware on the adapter card.

The Translator Unit, or head-end, is required for all configurations. Powered by a power transformer packaged with it, this unit transmits data through RF channels. It accommodates up to 72 users. If a larger network is required, customers must deal with Sytek, which has the expertise and hardware to support larger networks.

Each Translator Unit comes packaged with an 8-way splitter, connection hardware which can support another Base Expander, and a wrench. The Base Expander serves as a junction for the coaxial cable and has eight connections. In addition to the 8-way splitter that comes with the Translator Unit, there is another expansion tap available to support an additional Base Expander. The Base Expander can support up to eight additional Base Expanders (thus the 72 user limit).

Cabling consists of CATV broadband cable, coming in four cabling segment sizes (25, 50, 100 and 200 ft.). These cannot be cut or changed in size since that would require reattenuation. There are three distance kits to provide connection to additional Base Expanders.

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- The Short Distance kit (1 ft.) permits placement of the additional Base Expander and supports eight PCs at a distance of up to 200 ft.

- The Medium Distance kit will support a Base Expander at a distance of 400 ft. (cables for the 400 ft. are not included) and permits PCs to be located up to 600 ft. from the translator (200 ft. from the Base Expander).

- The Long Distance kit permits the Base Expander to be located 800 ft. from the translator, with an additional 200 ft. between the expander and the PC.

2. Software Components and Installation

The IBM PC Network Program requires the use of PC DOS 3.1.

The installation procedure for the Network Program is fairly straightforward. It consists of four user configurable software sub-programs (redirector, receiver, messenger, server) which support four different machine configurations. Disk and memory capacities vary with the options chosen. IBM provides a simple Installation Aid Menu that helps the manager configure the software. NETBIOS is packaged on the adapter card and does not require separate installation.

One copy of the IBM PC Network Program is required for each user on the network.

3. Strengths/PC Network

+ The Installation Aid Menu is straightforward and makes network setup and configuration fairly simple.

+ An SNA 3270 Emulation Program is available. PCs equipped with this capability can provide a communications gateway to serve 32 users with concurrent sessions to host processors.

+ The Network Request Key enables the user to leave the application and use the network. Users can switch back and forth between DOS and 3270 emulation without interrupting a 3270 session.

+ IBM has done a fine job of attracting ISVs and educating them on how to develop applications for the network.

+ Although limited, there is a migration path from the IBM PC Network to the Token Ring Network.

+ Access to a number of traffic and error statistics is provided, including number of errors, number of transmitted/received packets, etc.

4. Weaknesses/PC Network

- By announcing the Token Ring, IBM has virtually destroyed the chances for the IBM PC Network's future. IBM will have difficulty positioning this product except as a lower cost solution than Token Ring.

- The PC Network Program provides weak security; its print spooling capabilities are also not as robust as those of the STARLAN NETWORK.

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- Although this is a broadband network, no applications that would require broadband are supported. Additionally, using broadband bandwidth fully would require a more sophisticated and more expensive frequency translator.

- Installation is not simple. Special tools are required. There is little flexibility in cable lengths; cutting cable requires attenuation.

- For systems larger than 72 nodes, a different frequency translator is required and the customer must go to Sytek.

- The real-time messaging capability is limited. It requires that the receiver be powered up and on the network at the time of message receipt. In the menu mode the message is limited to 100 characters. Electronic mail with store and forward capabilities would be much more useful. However, IBM is only now contracting with a third party for this package.

- The menus take over the whole screen; this capability does not provide windowing or the ability to have multiple menus/submenus on the screen at the same time the way the STARLAN NETWORK does.

5. Ease of Operation/PC Network

Operation of the network is fairly straightforward. At the time of its announcement, the IBM PC Network was considered to be the industry standard from the perspective of ease of use and end user interface. In addition to a command line interface, the PC Network program provides a menu-driven interface. While it does not have "sexy" windowing capabilities and no longer represents the state-of-the-art (AT&T's STARLAN NETWORK, 3Com's 3+ and Novell's Advanced NetWare all have better menus), it is an adequate end user interface.

6. Documentation/PC Network

IBM has done a good job of providing clear documentation. Installation instructions are straightforward and abundantly illustrated.

7. System Management Experience Required/PC Network

The IBM PC Network is easier to configure and manage than most networks, but networking experience is helpful to operate it.

8. Remarks/PC Network

The marketability of this product has virtually been destroyed with the Token Ring announcement. Refer back to the Target Market section in the IBM company overview above, to understand how this product is being positioned against the Token Ring Network. In order to make the product more attractive, IBM reduced the price of the PC Network adapter cards on the day the Token Ring Network was announced.

IBM now distributes Novell's NetWare software for use on the IBM PC Network hardware.

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C. Product Analysis: IBM Token Ring

Network At A Glance

Network Type:	Baseband
Data Rate:	4 Mbps
Media:	Coax Shielded Twisted Pair Unshielded Twisted Pair
Access Method:	Token Passing Ring
Topology:	Ring/Star
No. of Devices:	Data Grade: 200 Unshielded Twisted Pair: 72
Max. Distance:	Single Closet: Data Grade: 990 ft. Unsh. Tw. Pr.: 330 ft. Multiple Closets:* Data Grade: 300 ft. Unsh. Tw. Pr.: 150 ft.
Server Type:	IBM XT, AT Series/1 (via gateway)
Devices Supported:	IBM PC, XT, AT IBM Portable
Services:	Disk Sharing File Sharing Messaging Print Spooling Electronic Mail**
Gateways:	SNA Asynch S/1 Gateway PC Network Gateway

* Data Grade wire supports 12 closets; Unshielded Twisted Pair supports 2 closets.

** Via 3rd Party.

1. Hardware Components and Installation

The main hardware components are the Network Adapter card, the Multistation Access Unit (MAU), and the cabling system.

The adapter card, which provides Levels 1 and 2 of the ISO model, requires a full size expansion slot on the IBM PC, XT, AT or IBM Portable; it cannot be used in the PC System Expansion Unit (5161). It is not yet evident whether this adapter card can be used on non-IBM devices. An attachment cable (PC Adapter Cable) is required to connect the adapter to the network cabling system. It costs $35 and is not included with the adapter card.

The MAU is a passive hub that permits the interconnection of up to eight devices in a star-wired topology. Multiple MAUs can be interconnected in a ring via IN/OUT connectors at either end of the MAU. This configuration can accommodate up to 260 devices. The MAU can be tabletop or wall-mounted in a room or closet (rack and housing are not provided by IBM). By-pass circuitry prevents loss of data if device or cable is defective.

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Network cabling can be either IBM's Type 1 or 2 data grade cable (coax or shielded twisted pair, respectively) or Type 3 unshielded twisted pair (Type 22 or 24). This is a major reversal of policy for IBM since IBM had been persistent in telling customers that unshielded cable would not be adequate for data communication.

Note the severe restrictions imposed by use of Type 3 wire:

- Data grade cable supports 260 nodes/network; unshielded twisted pair wire supports 72 connections.
- Data grade wire accommodates 990 ft. in single closet configuration, 300 ft. in multi-closet configuration. Unshielded twisted pair permits 330 ft. in single closet configuration, 150 ft. in multi-closet configuration.
- While 12 closets are supported using data grade wire, only two closets can be supported if unshielded twisted pair is used.
- If data grade wire is used at device level, distance between closets is 660 ft.; if unshielded twisted pair is used, the distance is 400 ft. Only Type 1 cable is used between closets.

Different media cannot be intermixed between device and wiring closet.

The two-jack face plate connects the telephone and workstation to network cabling. That cabling leads to the punch down blocks in the closets where phone and data signals are split. Type 3 Media Jumper Cable is used to run signals from the block to the MAU.

2. Software Components and Installation

The two software components required for the Token Ring Network are the NETBIOS Program and the IBM PC Network Program. NETBIOS, which was previously packaged on the network adapter card on the IBM PC Network, now comes on a separate software diskette. NETBIOS requires 46K of memory.

Judging from the installation procedures required for the IBM PC Network Program, it is a relatively simple installation procedure, although it now requires an additional diskette. IBM has provided a simple Installation Aid Menu that helps a network manager configure the software.

Also available as an optional package is the APPC/PC which provides LU 6.2 support. This allows peer-to-peer conversations between intelligent workstations and applications running on hosts (thus eliminating the need for dumb terminal emulation).

Several gateway packages are also available:

- PC Interconnect: This program links an IBM PC Network to a Token Ring Network, but does not provide generic bridging between multiple PC Networks or Token Ring Networks. The program, which requires 256K of memory, two adapters and the NETBIOS program, runs on a dedicated PC. Note its limitations under Weaknesses.
- SNA 3270 Emulation Program: This software also runs on a dedicated PC

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and provides connectivity between PCs on a Token Ring Network and SNA hosts.

- Series/1 Gateway: This software permits the use of Series/1 as a print or file server. Since the File/Print Server and Communications Server programs cannot co-reside, customers need one gateway PC to run the file/print server program and a second gateway PC to run the Communications Server software and SNA 3270 Emulation software.

- Asynchronous Communication Server (ACS): This program runs in the background mode of a client workstation. Each device equipped with this software will support up to two asynchronous links to a PBX or public switched network and provides the Token Ring/Rolm connection.

3. Strengths/Token Ring

+ The IBM name continues to be a main advantage. IBM has the power to set standards. A host of vendors have already expressed support of the Token Ring, including Ungermann-Bass, Proteon, Nestar, Novell, 3Com, etc.

+ The token passing access scheme provides fairly constant throughput rates even in heavily loaded environments and is generally less sensitive to smaller packets than other access schemes. However, extensive fault management techniques (such as token maintenance) are required in token ring (but not in CSMA/CD). CSMA/CD networks typically perform better than the Token Ring in lightly loaded conditions.

+ Generally, bandwidth has little or no effect on throughput since the limiting factors in a PC networking environment are the speed of the processor and the efficiency of the network operating system. However, higher bandwidth may affect aggregate throughput, which may affect the practical size of a network. Due to its 4 Mbps bandwidth, the Token Ring can attain higher aggregate throughput than can the STARLAN NETWORK.

+ SNA support is a key issue for customers and it appears that SNA connectivity will be a key Token Ring strength.

4. Weaknesses/Token Ring

- THE TOKEN RING CONTINUES TO BE A PIECEPART SOLUTION AND DOES NOT ADDRESS THE BULK OF NETWORKING PROBLEMS THAT CUSTOMERS HAVE TODAY. Note that the ISN/PDS/STARLAN NETWORK combination provides a much more comprehensive solution.

- The announcement of unshielded twisted pair support will diffuse customer objections to the IBM corporate cabling scheme, but only temporarily. The extensive restrictions imposed on network configurations using Type 3 wire severely hamper the flexibility of installing/configuring the network.

- Unlike the STARLAN NETWORK, which provides a daisy chain configuration, the minimal TRN hardware configuration requires an MAU, which costs $660. This can be an expensive solution for a small group of users.

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- No support for S36 or 38 was announced. IBM has only announced the availability of the XT and AT as servers. Complicated gateways are required if a customer wants to use the Series 1 as a server.

- This network only supports DOS workstations, specifically IBM devices. It is uncertain whether compatibles will be accommodated.

- The asynchronous communications server (ACS) package is a costly option. It runs in the background mode on a PC and offers two asynchronous ports. (The two ports must be configured identically.) A server lacks sufficient memory to run the PC Network Program and ACS at the same time.

- Although a variety of gateways are available, these memory intensive programs require dedicated PCs and multiple network adapter cards. There are hidden PC costs for all of these solutions.

- Token Ring to PC Network Bridge is a low versatility, limited product. Bridge software runs on a dedicated PC and permits 16 names on each network to be known to the other network. Since file/print servers each require 3 names, only 5 servers on one network can be known to those on other networks. THERE IS NO GENERIC BRIDGING OF TOKEN RING OR PC NETWORKS. In other words, there is no bridging of multiple Token Ring Networks or bridging between multiple PC Networks.

- Software taxes the memory capacity of existing PCs.

- Although the LU 6.2 capability is an important feature, in addition to upgrading mainframes/processors to support the protocol, customers will also have to write their own programs for the APPC/PC interface.

- The availability of two networking solutions is sure to confuse customers. The PC Network is clearly not going to be enhanced. The few customers that have opted to lay broadband cable in anticipation of corporate networking via PC Network will certainly be at a disadvantage.

- Even before taking installation and media costs into consideration, the IBM solution continues to be priced 10%-15% higher than similar configurations via the AT&T STARLAN NETWORK.

- The PC Network Program provides weak security; its print spooling capabilities are also not as robust as those of the STARLAN NETWORK.

- The menus take over the whole screen; this capability does not provide windowing or the ability to have multiple menus/submenus on the screen at the same time the way the STARLAN NETWORK does.

- IBM's processor products represent separate developments and use different operating systems. They do not now communicate well with one another and it is unclear how they can be accommodated on future networks.

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5. Ease of Operation/Token Ring

Operation of the network is fairly straightforward. The Token Ring Network uses the same user interface as the PC Network. In addition to a command line interface, the PC Network program provides a menu-driven interface. While it does not have sexy windowing capabilities and no longer represents the state-of-the-art (AT&T's STARLAN NETWORK, 3Com's 3+ and Novell's Advanced NetWare all have better menus), it is an adequate end user interface.

6. Documentation/Token Ring

Based on IBM's clear documentation for the IBM PC Network, documentation for the Token Ring Network should be of consistent quality.

7. System Management Experience Required/Token Ring

Since networking experience is helpful to operate the IBM PC Network, the increased complexity, and additional gateways and options available on the Token Ring Network suggest that such experience will be even more critical.

8. Remarks/Token Ring

The press and customers have generally found the Token Ring announcement disappointing. The lack of a backbone network, coupled with the weaknesses described above, weaken this product in the short term, while destroying the marketability of the IBM PC Network. However, given the IBM name and its ability to set industry standards, this network can be expected to be a force to contend with.

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D. AT&T STARLAN NETWORK Versus IBM Token Ring Network

IBM's recent announcement of the Token Ring Network is significant; it continues to stimulate customer interest in PC networking products. As a product, however, it does not begin to address the bulk of networking problems that most customers have today.

Customers with a need for a comprehensive data networking solution must evaluate a vendor's total networking product line, including cabling schemes, backbone networks and PC networks. When this is done, it becomes clear that AT&T has a comprehensive and integrated data networking solution to solve a variety of data communication requirements.

With its announcement of the IBM Token Ring Network, IBM has only disclosed another piecepart without making clear how it integrates with the entire IBM networking strategy. This leaves customers without the appropriate information to make important long-term decisions.

Some customers are in the process of acquiring standalone solutions that address a specific group/departmental networking problem that needs a quick solution. Thus, they will directly compare the recently announced IBM Token Ring Network against the AT&T STARLAN NETWORK.

Two comparisons follow: one is a chart and the other a narrative that addresses implementation and differences in more detail.

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EXHIBIT IV-1
IBM Comparison Chart

	AT&T STARLAN NETWORK	IBM Token Ring Network
Topology	Daisy Chain, Star	Star-Wired Ring
Access Scheme	CSMA/CD	Token Ring
Type	Baseband	Baseband
Data Rate	1 Mbps	4 Mbps
Media	Unsh. Twisted Pair	Unsh. Twisted Pair Shielded Twisted Pair
Standards	IEEE 802.3	IEEE 802.5
Recommended No. Workstations		
Data Grade	N/A	260
Unshielded Twisted Pair	100	72
Supported Workstations		
IBM PC, XT, AT	Yes	Yes
AT&T PC 6300 & Compatibles	Yes	?
UNIX PC	Yes	No
3B2	Yes	No
Series/1	No	Yes
File Servers		
IBM XT, AT	Yes	Yes
Compatibles	Yes	?
UNIX PC	Yes	No
3B2	Yes	No
Series/1	No	Yes
Host Connectivity	Yes (via ISN & NIU)	No
Asynchronous Support	Yes	Yes
Closet Serving Radius		
Single-Closet:		
Data Grade	N/A	990 ft.
Unshielded Twisted Pair	800 ft.	330 ft.
Multi-Closet:		
Data Grade	N/A	330 ft.
Unshielded Twisted Pair	800 ft.	150 ft.

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EXHIBIT IV-1 (Continued)
IBM Comparison Chart

	AT&T STARLAN NETWORK	IBM Token Ring Network
Programming Interfaces		
NETBIOS	Yes	Yes
TLI	Yes	No
APPC/PC	No	Yes
SNA Support	Yes (via 3B2)	Yes
Gateways	No	Yes
Bridging	Yes	Limited
Applications Software	Same as PC Net	Same as PC Net
Network Diagnostics	Yes	Yes
Pricing per Workstation (including H/W & S/W, 8-10 ft. of wire, no inst.)		
2 PC Configuration	daisy chain: $720 star: $1010	$1170
3 PC Configuration	daisy chain: $720 star: $915	$1060
5 PC Configuration	daisy chain: $720 star: $835	$970

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EXHIBIT IV-2
System Comparison

Standards

- IBM Token Ring: Conforms to the IEEE 802.5 standards and supports an open system architecture.

- AT&T STARLAN NETWORK: Conforms to the proposed IEEE 802.3 draft standard for 1 Mbps CSMA/CD networks over unshielded twisted pair. This standard, initially proposed by AT&T, has gained industry-wide support; many vendors are working with AT&T to define this standard for personal computer networking.

  AT&T is committed to an open architecture based on standard protocols and industry standard interfaces.

Transmission Speeds

- IBM Token Ring: Provides a 4 Mbps transmission speed.

- AT&T STARLAN NETWORK: Provides 1 Mbps transmission speed. This is more than sufficient to support PC-to-PC traffic. Throughput on PC networks is typically far less than the advertised transmission speed, the limiting factor being the speed of the data transfer from memory or disk on the processor. It is anticipated that response times on the STARLAN NETWORK in conditions typical of most office environments will be similar to that of the Token Ring. The Token Ring Network does provide greater aggregate throughput but response times will differ only when the STARLAN NETWORK reaches saturation.

Cabling

- IBM Token Ring: The Token Ring has the announced ability to run over three media: coaxial cable, shielded and unshielded twisted pair. With this announcement, IBM has admitted to the appropriateness of AT&T's cabling solution.

- AT&T STARLAN NETWORK: From the very beginning, our network was designed to run on standard telephone wiring -- inexpensive twisted pair, an integral part of our corporate cabling scheme. This was done to provide customers with a low cost networking solution and accommodate existing wiring whenever possible. IBM's recent announcement has demonstrated to the customer that AT&T's solution has always been the solution of choice.

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EXHIBIT IV-2 (Continued)
System Comparison

Applications

- IBM Token Ring: Uses DOS 3.1, MS-NET Redirector Core Protocol, and NETBIOS Interface, so applications developed for the IBM PC Network also run on Token Ring.

- AT&T STARLAN NETWORK: Also uses DOS 3.1, MS-NET Redirector Core Protocol, and NETBIOS Interface. Software developed for the IBM PC Network is fully operational on the AT&T STARLAN NETWORK. AT&T has also developed the ISO-compatible Transport Level Interface for UNIX System applications.

Bridging

- IBM Token Ring: An IBM PC program links the PC Network to the Token Ring Network. It runs on a dedicated PC and connects networks at the NETBIOS level. It permits up to 16 names on each network to be known on the other. File/print servers require 3 names. Thus, only 5 servers can be known to the other network. This is a low versatility interface with intensive protocol processing and is bound to have poor performance. It does not address the generic internetworking of rings or PC Networks.

- AT&T STARLAN NETWORK: Bridging of multiple AT&T STARLAN NETWORKS is accomplished via the SLIM-B, a bridge-oriented interface to ISN. This bridging capability joins multiple AT&T STARLAN NETWORKS together, regardless of location, and does not add extra protocol overhead. ISN also provides an Ethernet bridging service.

Entry Level Configurations

- IBM Token Ring: IBM claims to have flexible, modular configurations. The network requires a Multistation Access Unit (priced at $660) to support 8 lobes that run from the workstations to the access unit. Thus, the minimal hardware configuration is a Multistation Access Unit and two devices, each equipped with a network access unit. A minimal hardware configuration without cabling is approximately $1025/workstation.

- AT&T STARLAN NETWORK: AT&T supports two configurations: daisy chain and star. The daisy chain requires no central hardware. Per workstation hardware cost (with limited cable) is $595. The star arrangement uses a Network Extension Unit, which can support up to 11 individually-connected workstations, and more devices in a mixed daisy chain and star arrangement. Hardware for a minimally configured (2 workstation) star is approximately $880/workstation.

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EXHIBIT IV-2 (Continued)
System Comparison

Number of Devices

- IBM Token Ring: IBM supports from 2 to 260 attaching devices using data grade media and 2 to 72 devices with Type 3 telephone media.

- AT&T STARLAN NETWORK: In general the number of simultaneously active workstations should not exceed 100. This assures fast network performance under typical workloads. The network provides physical connections for up to 1,210 devices.

Workstations Supported

- IBM Token Ring: As announced, this product only interconnects IBM's PC-DOS devices.

- AT&T STARLAN NETWORK: Supports multiple operating systems. The network accommodates the following devices: PC 6300, PC 6300 PLUS, the UNIX PC, 3B1, 3B2 300/400. In addition to supporting MS-DOS and UNIX System devices on the same network, MS-DOS based workstations can use UNIX PCs and 3B2 computers as servers.

Servers Supported

- IBM Token Ring: IBM has made no provision for servers on the network other than the PC XT, PC AT and a cumbersome gateway to Series/1.

- AT&T STARLAN NETWORK: AT&T provides a range of servers to meet the different needs of customers. In addition to a concurrent workstation/server capability on MS-DOS devices equipped with hard disks, AT&T supports the use of two UNIX System devices as servers -- the UNIX PC and the 3B2 Computer.

Distance Limitations

- IBM Token Ring: The wiring distance from the work area to wiring closet in a single closet configuration over unshielded twisted pair wiring is approximately 330 ft., with 990 ft. supported over Type 1 and Type 2 cable. In a multiple closet configuration, these distances are reduced to 150 ft. on unshielded twisted pair and 330 ft. on data grade wire.

- AT&T STARLAN NETWORK: The serving radius for a star configuration is 800 ft. between the wiring closet and the most distant workstation on an individual leg.

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IBM CORPORATION

EXHIBIT IV-2 (Continued)
System Comparison

Asynchronous Support

- IBM Token Ring Network: Provides the Asynchronous Communications Server. This application runs in the background on a PC and offers two asynchronous ports to network PCs.

- AT&T STARLAN NETWORK: Supports asynchronous devices via the RS-232 Network Interface Unit (NIU). This device, which provides two ports, is available at a fraction of the cost ($750) of a PC configuration. In addition, the UNIX PC and the 3B2 can also provide the user with asynchronous ports. (The UNIX PC can serve as a **uucp** gateway.) Since the UNIX System provides a multi-tasking environment, using UNIX System-based devices to provide this service has little effect on local users.

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NESTAR SYSTEMS, INC.

A. Company Overview

Nestar provides two networking solutions: a simple network for linking IBM PCs and a high performance network based on a series of dedicated proprietary servers. Nestar's mainstream solutions, which use high performance servers, are expensive and therefore have been targeted at user groups with large numbers of PC's (30 or more) so as to justify the high cost of a system.

1. Product Line Overview

Nestar's product line has been called the PLAN (Personal Local Area Network™) Series. The number after the "Plan" refers to the capacity/type of server used. The product line includes:

- Plan 1000: This is a print server and the first in a new line of low end dedicated servers. This functionality is also integrated with the Plan 3000 and 4000 servers.
- Plan 2000: This software permits a PC XT to act as a concurrent workstation/file server and enables customers with IBM PCs to have a simple and cost-effective network for a very small number of users (about 5 is realistic). Any of the PCs on the network can share their hard disks or printers with other network users. A very simple set of services is provided which includes volume management, shared access to printers, and remote file transfer for remote access and network-to-network communication. (This product is specifically targeted as an OEM product.)
- Plan 3000: This desktop disk server product is available in four models with different capacities: 15 Mb, 24 Mb, 40 Mb and 56 Mb. Backup is available via a streaming tape cartridge with either 45 or 60 Mb of storage.
- Plan 4000: This floor mounted disk server is available in two models: 60 Mb and 137 Mb. It can support up to four drives for a total of 548 Mb. Backup is available via streaming tape. A dumb terminal is required to monitor the tape backup operations for both the Plan 3000 and 4000.

Nestar provides for easy upgrades from a Plan 2000 to the Plan 3000 and 4000. Additionally, these servers can be intermixed on the same network. Nestar uses ARCNET™ at the lowest levels and supports Xerox XNS™ as communications protocols.

Nestar also has a package called PLANPak™ Application Software, which packages a suite of five applications tailored to run on the PLAN 3000 and 4000 servers. These applications include Sorcim's SuperWriter™ WP package, SuperCalc™ 3 spreadsheet, Software Connections' LAN:DataStore™ data base package, Quest Accountant™ for business accounting applications, and ActionMail™ for electronic mail.

2. Sales and Support

Nestar does not have a strong sales/marketing/support organization; it makes its hardware and software available through a number of OEMs. Its technical support is limited. Since Nestar offers complex products, aimed at DP

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staff, Nestar anticipates that this support will be provided through OEMs or that customers will have the in-house expertise, sophistication and self-sufficiency to configure and administer the network.

Nestar provides a three day training program for a fee of $500. To encourage self-sufficiency, two trainees are accommodated at no charge with the purchase of a maintenance contract ($2,959/year).

3. Target Market

Nestar has typically aimed its products at sophisticated data environments with large bases of PCs (due to the high price of buying into a system). It has been particularly successful in universities and back office (heavy-duty processing) departments of Fortune 1000 companies.

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NESTAR SYSTEMS, INC.

B. Product Analysis: PLAN Series

Network At A Glance

Network Type:	Baseband
Data Rate:	2.56 Mbps
Media:	Coax IBM Twisted Pair IBM Optical Fiber Generic Optical Fiber
Access Method:	Token Passing
Topology:	Tree
No. of Devices:	255
Max. Distance:	Hub to workstation:. 200 ft. to 2000 ft. depending on cable End to end: 22,000 ft.
Server Type:	Plan 4000 Plan 3000 IBM XT, AT
Devices Supported:	IBM PC, XT, AT Apple II, III
Services:	Disk Sharing File Sharing Electronic Mail Print Spooling Remote Access Modem Pooling Backup
Gateways:	SNA Asynch Bisynch

1. Hardware Components and Installation

Nestar supports many types of cables (including the IBM Cabling System). The type of hub used is dependent on the cable. If using coax, hardware installation of Nestar's PLAN Series networks (which use Datapoint's ARCNET) is not appreciably more difficult than for any other coaxial cable based network. The usual problems associated with the installation of this type of network, such as the difficulty of working with the coaxial cable itself and the special tools required, are evident.

Four cable types and two hub types are supported, with distance limitations dependent on this. An active hub supports coax for 2000 ft., IBM twisted pair for 2000 ft., IBM optical fiber for 4000 ft., and "generic optical fiber" for 22,000 ft. Passive devices can support coax only.

Workstations are connected via a Network Interface Card (NIC). If networking three or more PCs, an LID, or hub, is used. This is the simplest configuration. Maximum distance between a workstation and an LID (or between any two LIDs) is dependent on type of hub and media used. Using ARCNET, the distance is 2,000 ft. However, through multiple LIDs, the maximum distance between any two workstations is 22,000 ft. Hubs range in capacity from 3-port to 16-port units. Currently, Nestar offers internally mounted hubs in its file servers but will be moving away from this approach.

The unique aspect of this network's installation regards future additions.

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NESTAR SYSTEMS, INC.

Stations are assigned unique addresses and may be connected in an arbitrary manner. Its "arbitrary" tree structure permits expansion of the network by adding "branches" off which nodes can be strung easily.

Although each network segment can only support up to 255 stations, larger networks can be constructed by using gateways or bridges to connect multiple networks.

2. Software Components and Installation

Software installation has been made easier through the use of a menu driven interface. This interface can also be used to boot up any of the standard applications packages that Nestar supplies with the network software. While not the simplest system on the market, its power has advantages.

3. Strengths

+ The ability to integrate Apple workstations is a strength, especially since Apple has been successful in educational environments, which represent a major opportunity for networking.

+ The range of available servers (more than any other network) and the availability of high performance servers with extended disk capacity is an asset. Server capabilities include 3270 and 3780 emulation servers, file transfer servers, print and file servers, communication servers, TELEX servers, etc. This functionality is integrated on the PLAN 4000 and 3000 line of servers.

+ Since this network is typically used in fully loaded environments, the token passing network access scheme, which is optimized for these environments, provides fairly constant throughput rates.

+ The power of this network's software, which provides true file sharing, is an asset.

+ The arbitrary tree topology provides flexibility for expansion and rearrangement.

+ The availability of a menu-driven interface is a key factor in the acceptance of this network by the end user.

+ The starter kit comes bundled with a variety of applications packages, including WP, spreadsheet, database, accounting, inventory control and electronic mail.

+ Nestar server software has been integrated with the mail package to produce a highly flexible EM system with remote communication capabilities.

+ Mass storage is not limited to dedicated file servers. Any hard disk device can offer its resources up for sharing.

+ Nestar permits the mixing of PLAN 3000 and PLAN 4000 servers on the same network and provides compatibility between them. This represents a nice migration path for customers.

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NESTAR SYSTEMS, INC.

4. Weaknesses

- The major weakness of the system is its complexity. There is simply no way to make this system work without dedicating DP personnel to manage it.

- It is one of the most expensive networks on the market and even then is only cost effective for systems with over 30 users. Therefore, it is inappropriate for small businesses/work groups/departments that are beginning to explore networking.

- While any workstation can be a print server for the network, it must do so in a dedicated mode only.

- Due to the available options for media and hubs, this can be a complex system to install and configure.

- A dumb terminal is required to monitor tape backup operations. This device can be attached to the server or be a network node.

- Although billed as a file server, data access is supported on the volume level only.

5. Ease of Operation

This network is slightly easier to use from the user perspective than from a system manager's. Nonetheless, its technical orientation would confuse the average office employee.

6. Documentation

The documentation is technically complex and poorly organized.

7. System Management Experience Required

Due to the complexity of the system, system management experience is a requirement.

8. Remarks

Consultants often recommend this product due to its functionality. This product is not suited for a typical office environment or for white collar office productivity applications. It is more suited to a technical or DP environment running transaction processing applications.

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NOVELL, INC.

A. Company Overview

Novell provides a series of solutions, representing both total (complete hardware/software) systems and pieceparts (software). The company is primarily interested in establishing its network operating system as a standard. It provides extremely efficient network software, which it ports to any LAN hardware. The current operating system software being shipped is called Advanced NetWare. This is a superset of their older NetWare.

As a software provider, Novell typically does not appear on charts depicting PC LAN shipments. Most consultants calculate market share on the basis of hardware/system sales. If Novell sells a version of its software for Corvus' Omninet, Corvus gets market share credit. Nevertheless, it is a significant and strategic competitor.

Novell's NetWare is unique in the industry and is positioned as an extremely efficient operating system, optimized for servers. In benchmark tests, hardware using Novell's software typically has better performance than hardware running native software. Special features contribute to improved performance/response times; these are typically not available on operating systems designed for PC networks. These features are: directory caching (network file allocation tables are stored in RAM), directory hashing (indexing of FAT tables, thus reducing need to search numerous directories), file caching (storing the most recently used files and programs in file server RAM), and elevator seeking (disk management feature which prioritizes access to disk based on current positional relationship of head to disk, rather than on "first-come first-served" basis).

Novell's software has additional appeal for smaller companies because it supports approximately 1600 software packages, a large portion of which are vertical market applications.

1. Product Line Overview

The main products that Novell sells are:

- NetWare/68 with NetWare/S: This is a total hardware and software solution. Novell provides the server, network hardware and software for this system. Advanced NetWare/S is the software that runs on NetWare 68.

- NetWare/86 with NetWare/*: Novell sells the network hardware (on an OEM basis) and software for this solution but depends on IBM XT and clones, rather than its own 68000 processor, as servers. Customers buy the general purpose server PC directly from IBM or others. The network hardware consists of products that Novell resells. Novell offers the following hardware on an OEM basis: G-Net™ (Gateway), proNET™ (Proteon), ARCNET™ (Standard Microsystems) and Ethernet™ (3Com). Novell provides a version of Advanced NetWare for each type of network hardware (NetWare/G, NetWare/P, NetWare/SM, NetWare/E respectively).

- NetWare/286 with NetWare/*: This is sold identically to NetWare 86, except that it uses a series of new Intel 80286-based proprietary Novell servers

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(286A, T286A, 286B, T286B) and the IBM AT and clones as servers. These proprietary servers vary only in their memory and disk storage capabilities. The prefix "T" refers to a tape unit that comes with the server.

- NetWare/*: Despite the availability of the above solutions, Novell's main positioning in the market is as a provider of software that runs on other vendors' hardware solutions. There are over 20 versions of NetWare. The suffix after the "/" designates which hardware it runs on. Pricing for the software is server-based and is $1,595, regardless of the hardware solution.

There are currently versions of Advanced NetWare for the following hardware:

- 3Com Etherlink
- 3M LAN/PC™
- AST PCNet II
- Corvus Omninet
- Davong Multilink™
- Gateway G-Net
- IBM PC Cluster™
- IBM PC Network
- Nestar Plan 2000
- Northstar Dimension™
- Orchid PCnet
- Proteon proNET
- Quadram Quadnet VI™
- Quadram Quadnet IX™
- Santa Clara Systems PCnet™
- Sperry USERNET™
- Standard Microsystems ARCNET
- Televideo Personal Mini™
- Texas Instruments EtherLink

Novell has announced that they will be providing a version of their software for AT&T's STARLAN NETWORK and for IBM's Token Ring Network.

Exhibit IV-3 is a chart representing Novell's product line.

Most of the software strengths and weaknesses of NetWare/S apply to other systems as well. In other words, Netware/G running on Gateway LAN hardware will share all of the operating system characteristics and software efficiencies of NetWare/S. Only hardware characteristics and system configuration will differ.

2. Sales and Support

In addition to a small direct sales force, Novell exploits a variety of authorized resellers, including dealers, distributors, OEMS, and retail chains for its software and hardware products. Some vendors, such as Televideo, Quadram, and Santa Clara, package NetWare with their own (or someone else's) hardware and sell it under their own name. Novell also acts as a reseller of hardware product for Gateway, Proteon, 3Com and Standard Microsystems. Versions of Advanced NetWare for systems with whom Novell does not have special agreements are typically available off the retailers' shelf.

Generally, Novell provides quality technical support. Authorized dealers provide site support. Authorized Service Centers receive technical support from Novell. Large end users to whom Novell has sold directly receive service (by prior agreement) through the Novell Customer Service staff at a field or corporate level. A hotline for questions is available.

NOVELL, INC.

Novell has established a fairly good education program which offers a number of courses for Administrator/End User/Reseller training. This includes separate courses on product line overviews, installation/maintenance, configuring systems, and general product education. Customized classes are offered as well. Handouts are professionally done. Novell's training is substantial for a company of its size. However, it needs to concentrate more on sales support and selling skills training for resellers.

3. Target Market

Novell targets companies via a small direct sales force; the majority of sales are made through Novell distributors, which target companies of all sizes that are looking for improved network performance via a number of hardware solutions. Specific targets vary with the Novell products being evaluated.

Tests have shown Novell's software to be compatible with approximately 1600 software packages, many of which are vertical applications. Novell software is attractive to customers interested in these packages. Many of these customers are smaller businesses that typically use networks to run production-oriented data processing applications such as inventory, warehousing, order entry, billing, etc.

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EXHIBIT IV-3
Novell's Product Line

System Name	Server	Network Hardware	Network Software
NetWare/68	Proprietary Motorola 68000	Novell (See attached writeup)	Advanced NetWare/S
NetWare/86	IBM XT & clones (8086, 8088 processors)	OEM: NetWare/G-Net NetWare/proNET NetWare/ARCNET NetWare/Ethernet	 Advanced NetWare/G Advanced NetWare/P Advanced NetWare/SM Advanced NetWare/E
NetWare/286	Proprietary 80286-based servers (286A, T286A, 286B, T286B) IBM AT and clones	Same as above	Same as above
NetWare/*	IBM and clones	Any vendor solution	Appropriate version of S/W to run on selected hardware

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NOVELL, INC.

B. Product Analysis: NetWare/68 with NetWare/S

Network At A Glance

Network Type:	Baseband
Data Rate:	300-600 Kbps
Media:	Dual Twisted Pair
Access Method:	Poll Port (Proprietary)
Topology:	Star
No. of Devices:	24
Max. Distance:	2000 ft.
Server Type:	Proprietary M68000
Devices Supported:	IBM PC, XT, AT AT&T PC 6300 Compatibles Victor 9000™ TI Professional
Services:	Disk Sharing File Sharing Electronic Mail Print Spooling Remote Access Bridging Backup Shared Modems
Gateways:	SNA X.25 Bisynch

1. Hardware Components and Installation

All workstations must be connected to a server that is equipped with expansion slots, four of which are for port cards. Each card has 6 ports for direct connection to workstations. There are two distance-sensitive workstation cards for each type of PC. One supports 600 Kbps data rate for distances under 500 ft.; the other supports 300 Kbps for distances over 500 ft. The back panel presents an array of cable jacks, to which twisted pair cable is attached in a star topology. The hard disk system must be located within 50 ft. of the file server. Each server must have a dumb terminal acting as a system console attached to it, also within 50 ft. of the server.

2. Software Components and Installation

NetWare runs on the file server and a DOS-specific version of the shell runs on each workstation. The shell takes up less than 20K of memory. Installation is fairly complex and lengthy, requiring a very good understanding of both the applications and MS-DOS file management. The hierarchical subdirectory and the associated permissions for file sharing, upon which the success of NetWare is based, require extensive planning. The administrator can use a menu to set up subdirectories and permissions but this menu does not cover the entire range of system capabilities.

3. Strengths

+ Novell uses an architecture optimized for a server function and uses a multi-user, multi-tasking operating system. Its design makes for efficiencies by

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removing significant overhead from the workstations and system. It is one of the best in the PC local area network market, presenting a super rich set of features. According to all performance testing, this system is the most efficient, presenting the user with the best response times.

+ A newly introduced set of menus, both for the administrator and the user, provides some nice features. A well-designed help facility is also available.

+ Multiple versions of DOS can be mixed on the same system because each PC is equipped with a DOS-dependent version of a shell.

+ The system supports a high degree of security, with numerous levels of permissions and passwords for user, group, and directory rights.

+ The system now supports multiple file servers. These servers are high performance servers with up to 8 Mb of memory and extensive disk storage capability. Multiple disk subsystems can be daisy chained for a total of over 2,000 Mb of storage.

+ Novell provides extensive, though somewhat overwhelming, training for those that wish it.

+ The electronic mail package (EMS) has a nicely designed context-sensitive help command which enables the user to ask questions in sentence form and receive appropriate help prompts. EXPRESS delivery is also available and provides a prompt on the screen.

+ A number of enhancements have recently been introduced, including remote access via a modem attached to one of the PCs on the system, the ability to bridge multiple LANs running NetWare, asynchronous communication, SNA support, and NETBIOS Emulation.

+ Novell claims that more than 1600 applications packages have been tested to run successfully on the network. All of these are published in a catalog.

4. Weaknesses

- This is a costly system that renders small configurations impractical.

- Administration is extremely complex, requiring a data-knowledgeable person.

- Despite the new menus and the extensive help capability, this is not a simple system for either the end user or administrator. The end user alone has over 40 commands in the command line mode, some with very subtle differences. The administrator has an additional 20 network monitor commands.

- Shared printers must be connected to the server and must be within 50 ft. of the server. User printers are not sharable.

- A dumb terminal is required within 50 ft. of the server to act as a system console. This allows monitoring of the system, reordering print jobs, broadcasting messages and logging off users. However, the system console commands and the workstation commands are separate and distinct.

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NOVELL, INC.

- The hard disk subsystem must be within 3 ft. of the server.

- The extensive permissions set, while it increases system security, can cause problems if the administrator does not understand the hierarchy or the design of the applications fully.

- Asynchronous communication is achieved via a dedicated PC on the network, which can be rather expensive.

- Administrative commands can only be run from the console.

5. Ease of Operation

The price paid for increased functionality on this network is the complexity of the network software. There are so many commands, often with very little difference between them, that they tend to overwhelm an inexperienced user.

6. Documentation

Documentation is comprehensive but complex and hard to digest.

7. System Management Experience Required

Without exception, a dedicated system manager is required for this network. This manager should have an excellent understanding of DOS file management. When the user IDs are set up on the network, the supervisor has to define each user's personal subdirectories. This task can be unwieldy if a large number of the 26 available drives that can be assigned to directories are used. Even a modest number of drive assignments per user can become a burden to manage.

8. Remarks

IBM now distributes Novell's NetWare software and lists it in its product catalog as a network program compatible with its PC Network hardware.

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NOVELL, INC.

C. Product Analysis: Netware/86 and 286 with NetWare/*

Network At A Glance

Network Type:	Hardware Vendor Dependent (HVD)
Data Rate:	HVD
Media:	HVD
Access Method:	HVD
Topology:	HVD
No. of Devices:	HVD
Max. Distance:	HVD
Server Type:	IBM XT, AT & Clones
Devices Supported:	IBM PC, XT, AT AT&T PC 6300 Compatibles Victor 9000 TI Professional
Services:	Disk Sharing File Sharing Electronic Mail Print Spooling Remote Access Bridging Backup Shared Modems
Gateways:	SNA X.25 Bisynch

1. Hardware Components and Installation

This is entirely dependent on the hardware being installed. See specifications for individual vendor solutions.

Novell resells the following hardware:

- Gateway's G-Net is a 1.43 Mbps CSMA/CA/CD network running over coaxial cable.
- Proteon's proNET is a 9.9 Mbps token passing ring network running over twisted pair, coaxial cable and fiber optic cable.
- Standard Microsystems' ARCNET is a 2.5 Mbps token passing bus network running over coaxial cable.
- 3Com's EtherLink is a 10 Mbps CSMA/CD network running over thin or thick coaxial cable.

2. Software Components and Installation

NetWare/* is almost exactly the same as NetWare/S; differences are hardware dependent. Refer to NetWare/S for specifics.

The * in NetWare/* refers to the specific version of NetWare as ported to specific hardware solutions.

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UNGERMANN-BASS, INC.

A. Company Overview

Ungermann-Bass (U-B) designs, manufactures, and markets a total local area network solution. Its networking products include: Net/One, a backbone general purpose network to interconnect hosts and processors via a variety of black box products and Net/One PC Connection, a microcomputer network. It has differentiated itself by providing numerous versions of its network -- baseband and broadband -- and the ability to run on multiple media, including coax and fiber. Additionally, U-B has recently announced the ability to support twisted pair wiring. This flexibility was designed to accommodate companies that have already chosen or are leaning toward a specific cabling solution.

In addition to announcing a Token Ring-compatible product, U-B has made a strong commitment to provide a high-speed LAN (50+ Mbps). In 1984, U-B entered into a joint venture with General Electric to develop LAN products for the factory environment. It has worked with standards bodies to incorporate MAP standards into their products. In May, a multimillion dollar end user contract to install LANs at five General Motors plants was awarded to U-B.

Although U-B is not generally perceived as a strong PC network provider, we have included it among our write-ups because, as a total system provider, U-B's combined products represent a significant competitor against the total AT&T solution which includes ISN and the AT&T STARLAN NETWORK. U-B considers its primary competition to be AT&T and IBM.

U-B has chosen not to compete directly with IBM, but to develop its product line in conformance to IBM standards. This has also resulted in a joint venture with Intel and Microsoft that enables U-B, on its Personal Connection product, to run IBM compatible applications.

1. Product Line Overview

U-B has two main products:

- Net/One: This is U-B's general purpose backbone network. It comes in two versions: a baseband and broadband version. The baseband version is Ethernet-based and runs at 10 Mbps on coax. The broadband version runs on fiber. U-B provides a number of black box devices which act as network interface units, and which represent smart network processors.

- Personal Connection/OpenNet: This is the Net/One product designed to interconnect intelligent workstations. It is available in either baseband or broadband implementations. The PC Connection can connect with other U-B LANS through bridges and generally is used as part of a much larger network as opposed to a standalone microcomputer-based LAN solution. U-B's joint venture with Intel and Microsoft provides a total PC networking solution called OpenNet. It uses Intel components for the third and fourth levels of the ISO model and relies on MS-NET software for upper layers.

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2. Sales and Support

U-B generally handles sales and installation although it does use authorized distributors to install and sometimes sell its products. These distributors often specialize in the installation of cabling. OpenNet, as a prepackaged product, is available through a number of retailers.

U-B hopes that service and support will differentiate its product in the marketplace. To this end, U-B has launched an extensive campaign to support domestic and international customers. It has established a network of field operations that provide sales, service and technical support on a regional basis. Its European support organization in Lausanne, Switzerland, provides such services to distributors and OEMs.

U-B formed a System Integration Group to offer specialized networking solutions on an individual basis. These special services include site planning, system design, requirements analysis, hardware and software support for all Net/One implementations.

U-B has signed a third party maintenance agreement with RCA. The agreement gives customers nationwide service coverage with 4-hour response if the call is received before noon.

U-B generally warrants its hardware for 90 days from day of shipment. Customers can return products to the company's repair facility in Santa Clara, California. Customers are billed for repair services if the returned products are not under expressed warranty.

U-B provides training and support for both hardware and software to all customers and distributors. The company offers standard training courses on a periodic basis, as well as courses to address specific customer requirements. Specifically, the sales force will provide several hours of training as an overview for customers. Intensive (and very expensive) training is provided at a two day course in Santa Clara for Network Managers. Site training will also be provided as an option.

U-B works with its distributors to provide seminars throughout the country to potential end users. This provides an avenue for resellers to describe their services, while relying on U-B to provide product overviews.

A major problem is the lack of corporate staff support to consolidate software updates. The sales force must provide the expertise and frequently has a difficult time doing so.

3. Target Market

U-B has targeted its products to large corporate environments and, through its support of multiple cabling options, has optimized the network for such customers. By entering the industrial LAN arena, it hopes to sway additional large industrial corporations to buy into a total U-B solution.

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UNGERMANN-BASS, INC.

B. Product Analysis: Personal Connection/Open Net (MS-NET Software)

Network At A Glance

Network Type:	Baseband/Broadband
Data Rate:	Baseband: 10 Mbps Broadband: 5 Mbps
Media:	Broadband Coax Baseband Coax Will soon support Twisted Pair
Access Method:	CSMA/CD (Intend Token Ring also)
Topology:	Bus
No. of Devices:	90 via thin coax
Max. Distance:	1640 ft. via thin coax
Server Type:	IBM PC, XT, AT
Devices Supported:	IBM PC, XT, AT
Services:	Disk Sharing File Sharing Print Spooling Remote Access Bridging Modem Pooling (via Net/One)
Gateways:	SNA Bisynch Asynch

1. Hardware Components and Installation

U-B provides two Network Interface Units (NIUs) for connecting PCs to the network. The Personal NIU costs $850 and is equipped with 128K of memory that allows the communications protocol processing to be offloaded from the IBM PC. A low priced NIU (called the Personal NIC) provides a transceiver to support thin Ethernet cabling, and is a less expensive, less intelligent alternative to the NIU. U-B recommends that workstations use the NIC, while servers use the NIU.

Other hardware includes the network medium and a variety of equipment to support broadband (translator unit, RF modems, broadband versions of the NIUs, network taps). Repeaters are also available.

Net/One hardware also provides a number of serial and/or parallel I/O modules which provide RS232 ports for the interconnection of modems, communication lines, hosts and terminals.

2. Software Components and Installation

In order to move closer to IBM standards and to support IBM PC Network applications, U-B has recently replaced its native network software, called DiskShare™ and PrintShare™, with MS-NET. Software installation is fairly simple since MS-NET does not present many options to either the network manager or user. Since MS-NET is not entirely stable, however, mistakes during set up can easily bring the network down.

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The older DiskShare, PrintShare and MailShare™ network software represented a comprehensive feature set, including the support of concurrent workstation/servers, support of diskless PCs through a remote boot capability, and a robust print spooling feature. The network OS used a multi-tasking kernel and provided good response times. However, U-B opted to replace this with a less robust software set in order to gain IBM compatibility.

3. Strengths

+ The hardware and media options on the network provide the user with a great deal of flexibility, especially if the customer already has another networking solution on the premises.

+ The availability of a total solution, not just a PC network, is attractive to large corporate customers. PCs on the Personal Connection have access to SNA support, including terminal emulation, coax eliminators, cluster controllers, etc., as well as the ability to access resources on the backbone network.

+ U-B's announcement of a twisted pair version of the network makes for a relatively inexpensive solution.

+ The joint venture with Intel and Microsoft should expand U-B's customer base.

+ OpenNet can also support the XENIX™ operating system, accommodating Intel's UNIX System boxes on the network.

4. Weaknesses

- The major drawback to this solution is the lack of robust software. MS-NET is not a particularly rich or flexible program. Net/One's Printshare, an older version of the print spooling software, was considered a very sophisticated program. MS-NET is particularly weak in this regard. U-B replaced the older program with MS-NET in order to move closer to IBM standards and to support IBM PC Network applications on Personal Connection.

- MS-NET still has significant bugs in its software and is not entirely reliable.

- There is no menu-driven interface on MS-NET, only a command line mode.

- Although multiple servers can exist on the network, these servers must be dedicated because MS-NET cannot support concurrent servers as yet.

5. Ease of Operation

Although unforgiving of user mistakes, MS-NET is fairly simple to operate, with a limited number of commands for the user to master. However, the absence of a menu-driven interface can represent difficulties for new network users.

6. Documentation

Documentation can best be evaluated as fair.

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7. System Management Experience Required

Since the software is so limited, no extensive system management experience is required. However, since the software often needs to be rebooted if users have inadvertently given incorrect commands, it is helpful to have networking experience.

8. Remarks

Although U-B had hoped to enhance its product with MS-NET, it has gained little more than record/file locking and compatibility with IBM PC Network applications. These advantages have not provided U-B with a truly strong PC networking product. MS-NET needs to be enhanced before the Personal Connection is an attractive product.

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AT&T STARLAN NETWORK Marketing Guide/Product Description

V. PRODUCT DESCRIPTION

AT&T's STARLAN NETWORK is an inexpensive, high-performance local area network for intelligent workstations, appropriate for work groups and departments in large, medium and small businesses. It allows PCs to communicate at speeds of up to 1 megabit per second (Mbps) over standard telephone wire -- and supports network applications such as file sharing, printer sharing, electronic mail, etc.

The STARLAN NETWORK is optimized for two to 50 simultaneously-active workstations (up to 100 workstations depending on the application). The network's modular design and flexible configurations make it cost-effective for any number of workstations within these limitations. The network can connect PCs over a radius of up to 800 feet -- up to 1600 feet between the most-distant devices.

At the physical and data link protocol levels, the STARLAN NETWORK is the IEEE 802.3 draft standard for 1 Mbps CSMA/CD networks over unshielded twisted pair wiring. This draft standard, which is described in more detail below, has gained industry-wide support; many vendors are working with AT&T to define this standard for personal computer networking.

A. Designed for Business

The STARLAN NETWORK is designed to give businesses the features they need most in a PC network. It:

- Works with the most popular DOS-based personal computers.
- Supports the most convenient, flexible and inexpensive wiring solution, and
- Integrates with other products for a complete solution to business data connectivity needs.

1. Support for a Variety of Equipment

The STARLAN NETWORK's open architecture connects a wide variety of workstations and other devices. Two especially important aspects of this are:

- The STARLAN NETWORK supports both MS-DOS and UNIX-System computers on a single network, and allows MS-DOS workstations to use UNIX-System devices as servers.
- The STARLAN NETWORK allows a wide variety of computers to act as file servers, so customers can use their existing PCs or purchase the equipment that best suits their needs. Also, a PC may operate concurrently as both a server and a workstation. (Networks that do not have MS-DOS workstations do not require servers.)

The STARLAN NETWORK supports the following workstations and other devices:

- AT&T PC 6300 and 6300 PLUS personal computers (requires DOS Version 3.1 or later).
- IBM PC, PC XT and PC AT, in addition to other compatible personal computers running MS-DOS Version 3.1 or later.

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- AT&T UNIX PC models 7300 and 3B1 (requires UNIX PC System Software Version 3.0 or later).
- AT&T 3B2 processor.
- All serial and parallel printers supported by the PC 6300, UNIX PC, or 3B2. These include AT&T dot matrix printers models 473 and 475; AT&T daisy wheel printers models 455, 457, and 458; the Hewlett-Packard LaserJet™ Printer and other popular printers.
- Asynchronous devices such as printers, modems, etc., as offered by a variety of manufacturers (a standalone network interface will initially provide support for terminals only).

2. Standard Telephone Wiring

The STARLAN NETWORK uses standard telephone wiring -- 4-pair (24-gauge) unshielded twisted pair wire cable -- and standard 8-pin connectors and modular jacks to connect devices. This wiring is easy and inexpensive to install and to reconfigure. At the same time, it supports data transmission speeds and reliability that easily meet the requirements for PC local area networking.

In many cases, the STARLAN NETWORK can share existing building wiring with the telephone/PBX system. Since the network uses only two of the four pairs, the remaining two pairs may be used for voice communication. This means the network can be up and running very quickly with only a minimal wiring effort -- and minimal cost.

3. Part of a Total Networking Solution

The STARLAN NETWORK is part of AT&T's integrated approach to business data networking. The other major components are:

- **The AT&T Premises Distribution System (PDS)**, providing a solid foundation -- a complete corporate wiring scheme -- for connecting voice and data products.
- **The AT&T Information Systems Network (ISN)**, providing a backbone data network for businesses with sophisticated data processing and information sharing requirements, to connect terminals, hosts, PC networks, and other equipment within or between buildings.

The STARLAN NETWORK works alone or in conjunction with the above products to provide PC workteam connectivity wherever it is needed. Whether the customer needs a simple PC network, or a sophisticated data system that integrates all of the customer's equipment -- only AT&T offers a comprehensive solution.

B. Supports Industry Standards

In keeping with AT&T's commitment to open architecture, the STARLAN NETWORK conforms to industry standards for PC network hardware and software. Conformance to standards protects the customer's investment by assuring that the STARLAN NETWORK will work with current and future hardware and software offerings from AT&T and from other vendors.

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1. 802.3 Standard CSMA/CD

The STARLAN NETWORK is the draft standard for 1 Mbps CSMA/CD communication over twisted-pair wire, as described in the Institute of Electrical and Electronic Engineers (IEEE) draft 802.3 standard.

CSMA/CD stands for Carrier Sense Multiple Access with Collision Detection. This protocol is specifically optimized for the type of short-distance, intermittent traffic typical in a network that connects intelligent workstations. For a technical description of how CSMA/CD works, refer to Appendix A.

2. Software Standards

The STARLAN NETWORK complies with industry standards for networking and applications software. This enables STARLAN NETWORK customers to run off-the-shelf software.

In the MS-DOS environment, the STARLAN NETWORK supports MS-DOS Version 3.1 and the Microsoft Network's Core Protocols. It also supports the IBM NETBIOS interface. As a result, the STARLAN NETWORK can run applications software developed for MS-NET and the IBM PC Network (as well as the IBM Token Ring Network). This gives STARLAN NETWORK customers access to a large and growing pool of software products.

The STARLAN NETWORK also has full support for UNIX System V, which is the operating system used for networking UNIX PCs and 3B2 computers.

C. STARLAN NETWORK Hardware

The STARLAN NETWORK uses modular, inexpensive components that allow customers to easily expand their networks as their workteams grow. Different network configurations use different pieces of hardware, but even the largest, most elaborate network requires only three types of components:

- Network Access Unit (NAU).
- Network Extension Unit (NEU).
- Network Interface Unit (NIU).

1. Network Access Unit (NAU)

Each workstation on the network requires an NAU -- a printed circuit board that fits into one of the computer's expansion slots. A different model is available for:

- MS-DOS based workstations including the AT&T PC 6300, PC 6300 PLUS, and compatibles including the IBM PC, PC XT and PC AT.
- AT&T UNIX PC and UNIX PC 3B1.
- AT&T 3B2 models 300, 310 or 400.

The basic building block of the STARLAN NETWORK, the NAU enables a workstation to communicate over the network wiring. In a daisy chain configuration, the NAU is the only network hardware component required. When purchased, the NAU comes with:

- A 10-foot modular cord (to connect with other workstations).

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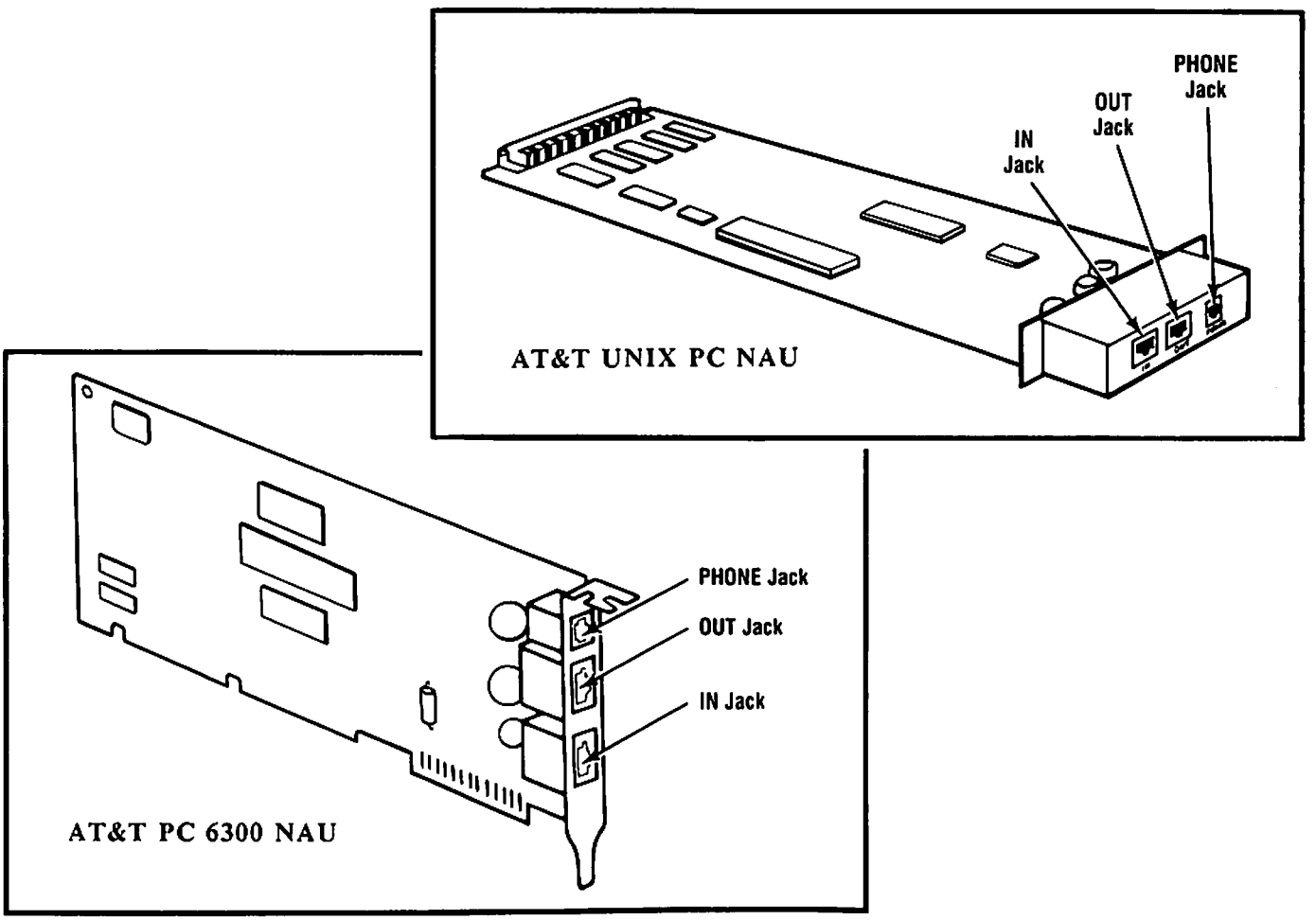
- Diagnostic software.
- An installation manual for the NAU.

The NAU (see Exhibit V-1) has three modular jack connectors. The "in" and "out" jacks connect to other network devices. The "phone" jack allows users to plug an analog telephone into the back of their workstations. This permits the analog phone and workstation to be connected to building wiring via a single wall outlet.

Whenever necessary, NAUs have user-adjustable option settings for interrupt request, I/O address, and RAM address, so they can be made compatible with other expansion cards. For more information about this and other technical aspects of the NAU, please see Appendix B.

EXHIBIT V-1
NAUs



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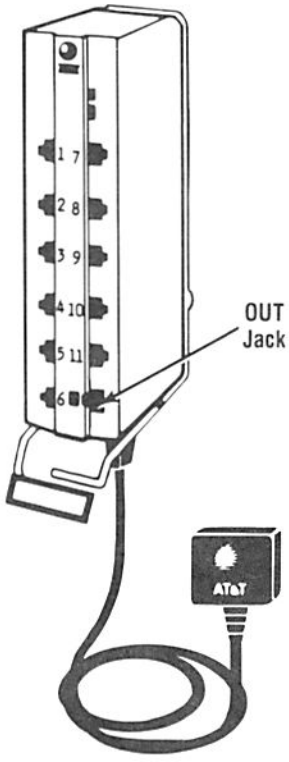
2. Network Extension Unit (NEU)

The NEU is the central hub of a star configuration. It connects up to 11 workstations and performs signal amplification and collision detection for the network. About the size of a cereal box, the NEU (see Exhibit V-2) is easily installed on an office wall or in a wiring closet.

EXHIBIT V-2
NEU



To connect a workstation to the NEU, simply run a modular cord from the workstation NAU's "out" jack to one of the 11 "in" jacks on the NEU. The NEU's 12th (and last) jack is an "out" jack that can be connected to another NEU, allowing the network to expand into a two-tier star configuration (see below). For more information about the technical aspects of the NEU, please refer to Appendix B.

Two indicator lights make it easy to monitor network activity on the NEU. Depending on whether the lights are on, off, or blinking, the network administrator can identify whether there are any problems on the network, whether power is being supplied, etc.

When purchased, the NEU comes with:

- A wire mounting frame that holds the NEU.
- A label holder that attaches to the wall mounting frame.
- Two wall anchors and screws for attaching the frame to a wall.
- Pre-printed labels to identify the NEU by number (especially important in networks that have more than one NEU).
- A power transformer and cord to provide low voltage AC current to the NEU.
- An NEU Installation Manual.

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3. Network Interface Unit (NIU)

The NIU is a standalone device that provides two standard RS232-C connectors for asynchronous devices such as printers, host computers, modems, and terminals. The NIU also has an "in" jack, an "out" jack and a "phone" jack. The RS232-C ports allow simultaneous and independent network access for two devices communicating at speeds of up to 9.6 Kbps.

Once connected through an NIU, the asynchronous device can function as though directly connected to a network server. Terminals can use the NIU to access a UNIX PC or 3B2 on the network. Another function of the NIU is to provide modem pooling to connect to remote computer services.

The NIU is a Phase 2 product (see the product rollout schedule at the end of this section). Initial support will be provided for terminals only; support for other asynchronous devices will become available later. For more information about the technical aspects of the NIU, please refer to Appendix B.

D. Network Configurations

The STARLAN NETWORK supports a variety of configurations, and these are easy to expand as the need arises. Once the customer buys a hardware component, it never becomes obsolete -- to expand the network, the customer merely adds more equipment while keeping the existing components.

The choice of configuration depends primarily on the number of workstations that need to be connected, and the distances between them. When reading the descriptions that follow, consider these points:

- The maximum number of workstations is the absolute number of physical connections available. The STARLAN NETWORK is optimized for 2-50 simultaneously-active workstations (up to 100 in light applications such as electronic mail and printer sharing), so keep this in mind when configuring the network. When counting connections, remember to include NIUs as well as PCs and 3B2s.

- The maximum distance between workstations is a safe limit for efficient network performance. The distance is measured in cable feet -- the actual length of wire between PCs. There is no minimum distance between devices.

For additional guidelines on how to design a network, refer to the Ordering Plan (Section VII).

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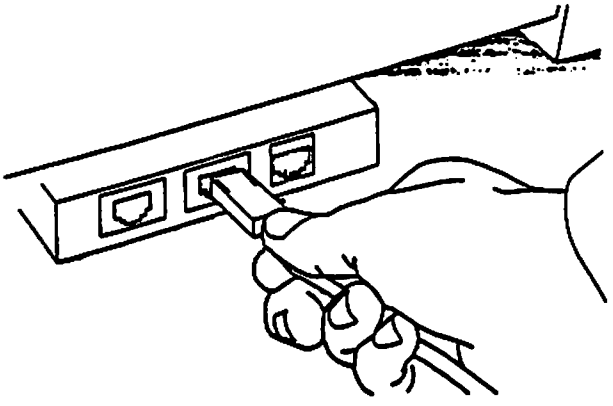
1. Daisy Chain Configuration

The daisy chain is the simplest and least expensive configuration. A wire runs from the "in" jack of one workstation's NAU to the "out" jack on the next. Unlike competitive networks, the STARLAN NETWORK requires no special tools to make this connection: modular cords simply snap into place (see Exhibit V-3).

EXHIBIT V-3
Modular Cords Snap Into Place



The daisy chain is ideal for small, entry-level networks. It does not require an NEU since the workstations simply connect with each other directly (see Exhibit V-4).

- Maximum number of workstations: 10.
- Maximum distance: 400 cable feet from first workstation to last. Within the chain, distance between PCs and other devices is not a factor.

Workstations can exchange data even when other workstations in the chain are turned off. However, adding or removing a workstation may break the chain and disrupt communications until all NAUs in the chain are reconnected.

2. Room Star Configuration

The room star supports more workstations and greater distances than the daisy chain, allowing more flexibility in the network design. One or more workstations can be disconnected without affecting the rest of the network.

One Network Extension Unit (NEU) acts as the center of the star. A wire runs from the "out" jack on each workstation's NAU to one of the 11 "in" jacks on the NEU (see Exhibit V-5). The NEU must be located within 10 feet of a power source that is not controlled by a switch.

- Maximum number of workstations: 11.
- Maximum distance: 800 cable feet from NEU to any workstation. Thus, two PCs may be as far as 1600 feet apart with the NEU equidistant between them.

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EXHIBIT V-4
Daisy Chain

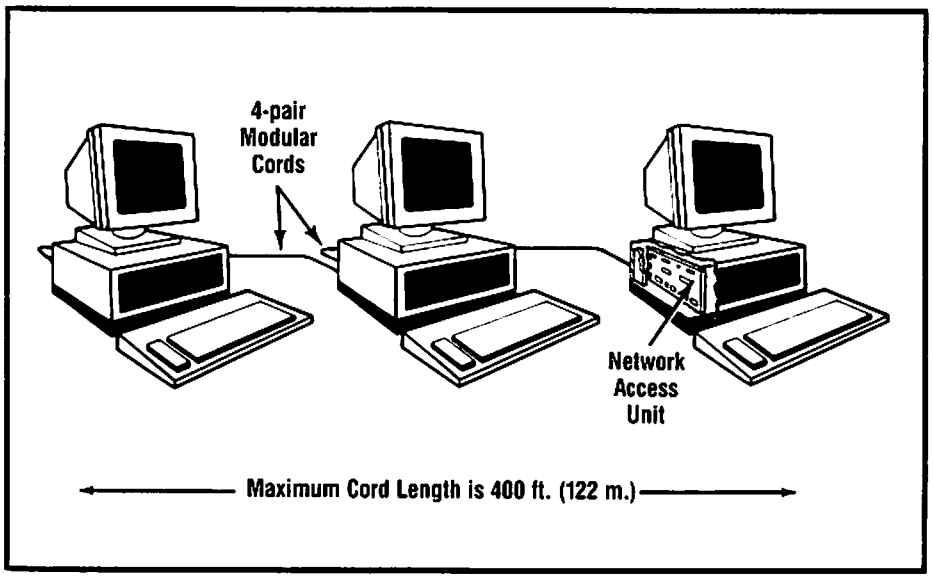

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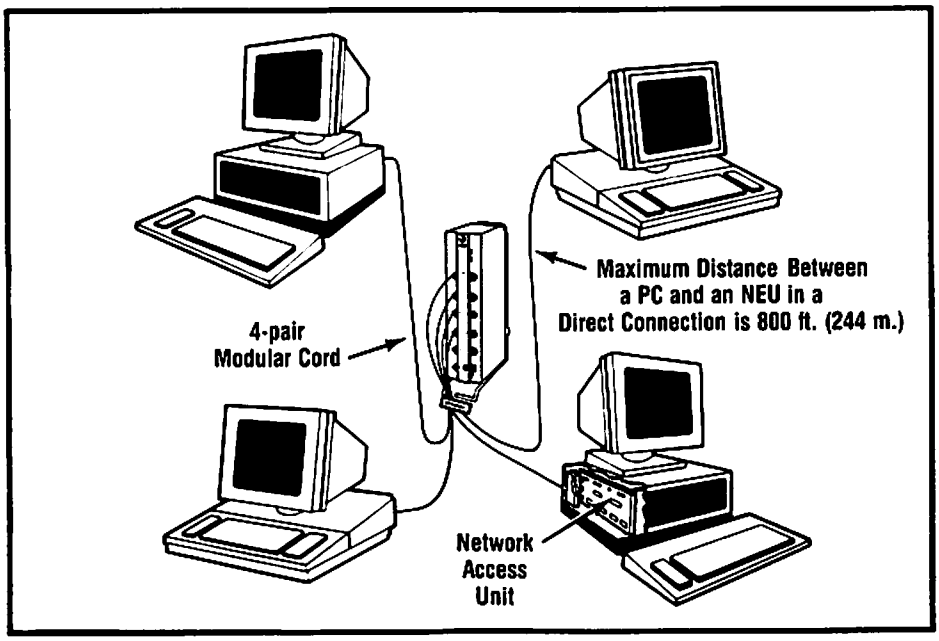
EXHIBIT V-5
Room Star



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3. Extended Star Configuration

Adding a daisy chain to one or more of the workstations on a room star creates an extended star. Up to nine workstations may be chained onto the NEU-connected PC (for a total of 10 workstations on the chain). Any of the workstations directly connected to the NEU may have daisy chains attached (see Exhibit V-6).

The extended star makes it easy to add workstations without purchasing additional NEUs.

Within each daisy chain, a PC cannot be disconnected without affecting the chain. However, a broken chain will not affect other parts of the network.

- Maximum number of workstations: 110 (i.e., 11 NEU connections times 10 workstations per daisy chain), although this is not a practical limit -- about 30 workstations per NEU is the recommended maximum for best performance.

- Maximum distance: the maximum distance from the NEU to the farthest workstation depends on how many devices are on the chain. Exhibit V-7 shows the maximum distance for a daisy chain connected to one or more NEUs.

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EXHIBIT V-6
Extended Star

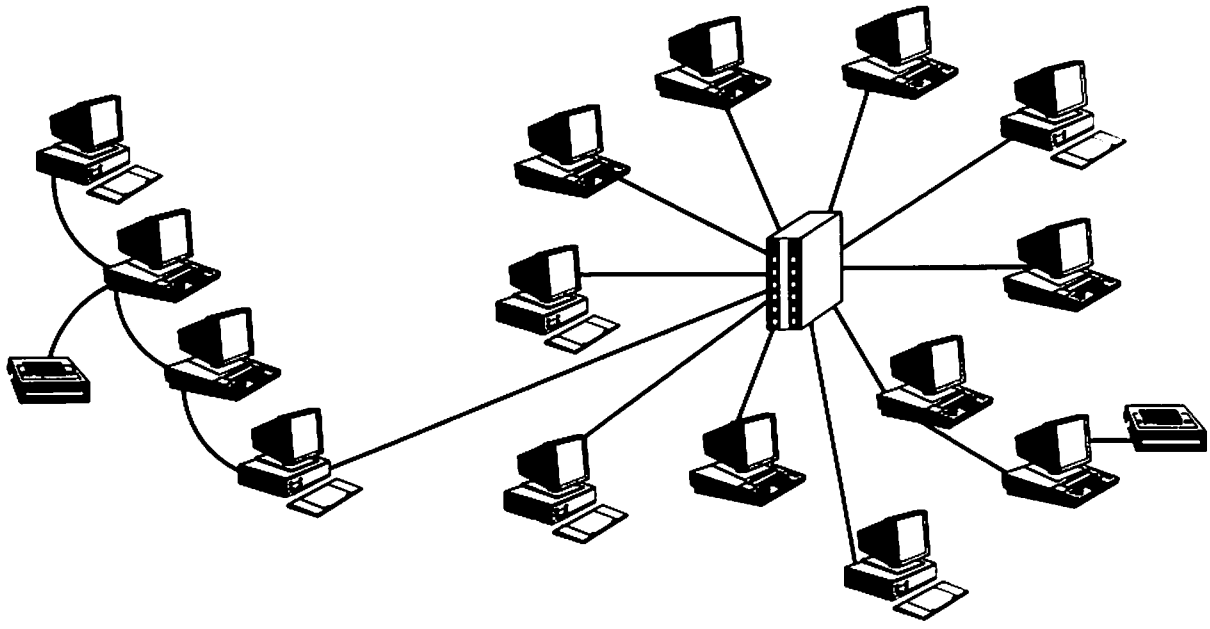

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EXHIBIT V-7
Maximum Distances For Star Configuration

MAXIMUM CORD LENGTH FOR A DAISY CHAIN CONNECTED TO AN NEU		
Number of Personal Computers in the Daisy Chain	**Maximum Cord Length for 1 NEU**	**Maximum Cord Length for 2 or more NEUs**
1	800 ft. (244 m.)	800 ft. (244 m.)
2	800 ft. (244 m.)	800 ft. (244 m.)
3	800 ft. (244 m.)	800 ft. (244 m.)
4	800 ft. (244 m.)	800 ft. (244 m.)
5	800 ft. (244 m.)	725 ft. (220 m.)
6	725 ft. (221 m.)	625 ft. (191 m.)
7	625 ft. (191 m.)	550 ft. (168 m.)
8	550 ft. (168 m.)	450 ft. (137 m.)
9	450 ft. (137 m.)	400 ft. (122 m.)
10	400 ft. (122 m.)	400 ft. (122 m.)

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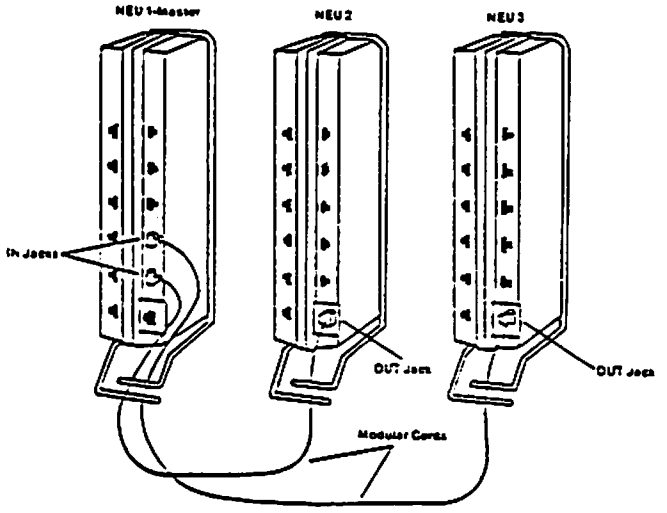
4. Two-Tier Star Configuration

The two-tier star has more than one NEU and allows even more workstations to be connected. The "master" NEU, which acts as the central hub, connects with up to 11 "branch" NEUs, or to regular network devices (workstations, NIUs, etc.). A modular cord runs from one of the "in" jacks on the master NEU to the "out" jack on the branch NEU (see Exhibit V-8).

EXHIBIT V-8
Two-Tier Star Configuration
(Two-Tier Hub with Master NEU and Two Secondary NEUs)



The two-tier star is used for networks whose size or growth cannot be accommodated by daisy chaining to a single NEU. For example, adding to a daisy chain may not be advisable if one of the following situations applies:

- The number of stations in each room limits the size of the daisy chain. A daisy chain cannot use building wiring to extend beyond a single room.
- Service interruptions due to rearrangement of daisy chained stations are not acceptable.
- Faster performance is required (a fully-loaded daisy chain or NEU may slow down during heavy use).
- Security of servers or critical users prevents their inclusion in a daisy chain.
- More than one station in a room is to use the "phone" jack (see discussion of the closet star below).

In any of these circumstances, a two-tier star may be advisable.

- Maximum number of workstations: although it is not a practical limitation, the two-tier star provides up to 1210 connections (i.e., 110 workstations on each branch NEU, times 11 branch NEUs).
- Maximum distance between NEUs: initial availability requires that the NEUs be co-located.

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- Maximum distance between branch NEU and farthest device: no more than 800 cable feet (for daisy chains, see Exhibit V-7).

- Maximum distance between any two devices: 1600 cable feet.

5. Closet Star Configuration

The closet star uses the building's telephone wiring and provides the capability of transmitting voice and data in the same bundle. This configuration is convenient for linking workstations together, especially between rooms (see Exhibit V-9). The NEU is mounted in the telephone wiring closet and is linked to the cross-connect block. Then by connecting the "OUT" jack of the NAU to a wall jack, and the user's analog telephone to the telephone jack on the NAU (as illustrated in Exhibit V-10), both voice and data are transmitted on the same line. The closet star may be arranged like any room star, extended star, or two-tier star configuration.

A closet star can be installed in any workplace. The existing wire may be used to carry STARLAN NETWORK transmissions as long as it conforms to the following requirements:

- Regular 24-gauge twisted-pair wiring must be used throughout the STARLAN NETWORK area. All PDS 4-pair wiring meets this requirement; so do many other wiring schemes, including older 25-pair and 6-pair telephone wiring, and systems from other vendors. Also compatible are 66-Type and 1A-Key System wiring schemes.

- Two wire pairs must be available: pair 2 and pair 3. Since analog telephones use pairs 1 and 4 for the voice signal and power, this presents no problem. Digital sets, however, may interfere with these pairs and therefore customers should use a two-jack solution. Note that voice and data signals travel on different wires in the same sheath.

- At least one NEU is required. At initial availability, NEUs must be co-located.

If daisy chains are used, only one telephone may be installed on each chain, and it must be attached to the workstation that is closest to the wall and to the NEU.

Unlike the other configurations, a closet star requires some technical expertise in wiring. Therefore, installation usually requires the services of an AT&T technician or other similarly qualified professional.

E. ISN Connectivity

For customers with sophisticated data communication needs, the STARLAN NETWORK works with AT&T's Information Systems Network (ISN) to seamlessly integrate PC users into the customer's entire data network.

1. ISN Overview

AT&T's Information Systems Network (ISN) is a backbone network that provides terminal-to-host and host-to-host connectivity throughout the customer's organization. Exhibit V-11 shows a typical ISN configuration.

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EXHIBIT V-9
Closet Star -- Transmitting Both Voice and Data

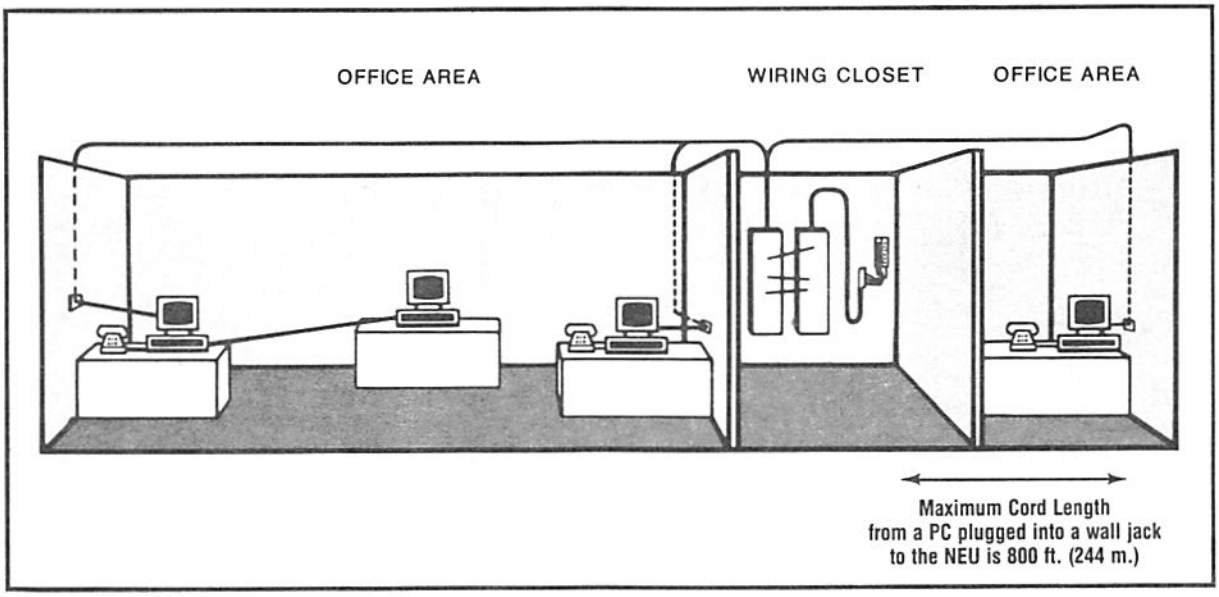

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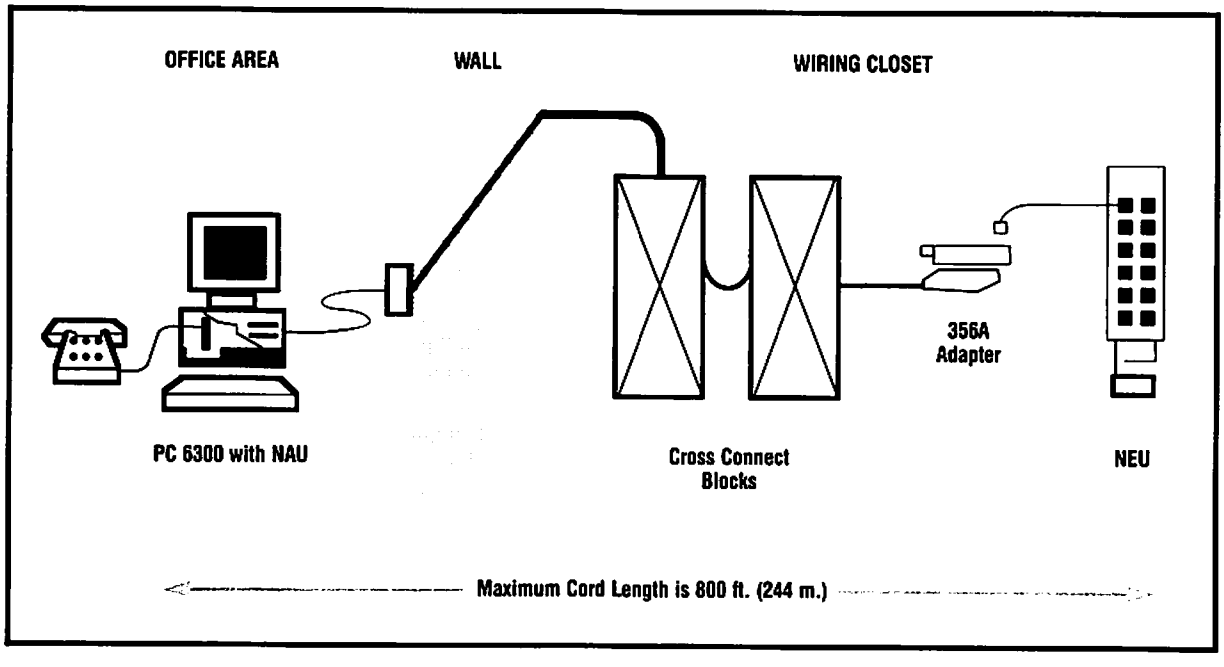
EXHIBIT V-10
Closet Star Connections



This is one example of how to wire a closet star -- in this case, using PDS. Other wiring systems (for example, 1A-Key or 66 Block) use different adapters.

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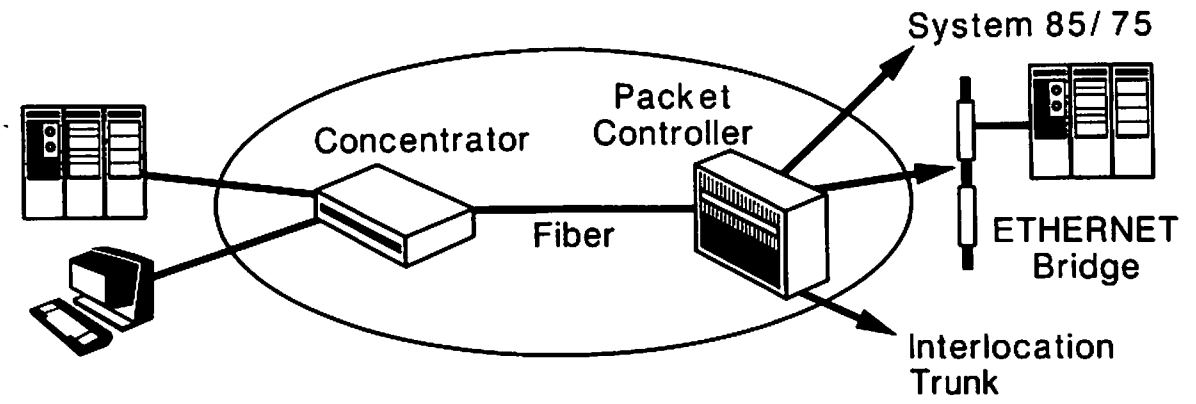
EXHIBIT V-11
The AT&T Information Systems Network (ISN)



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In conjunction with PDS wiring, ISN can serve a single building, multiple buildings or a much wider area. It uses a centralized-bus architecture that allows for easy modular growth in a star-like topology. ISN's open system architecture supports a variety of synchronous and asynchronous devices, allowing customers to preserve their current equipment investment.

The hub of an ISN system is the Packet Controller, with as many as 2240 EIA standard ports. It communicates directly with computers, terminals, and other devices, and it also connects to locally-installed Concentrators, using high-speed fiber optics cable. The optical cable is a fraction of the size of regular coaxial cable, but it provides state-of-the-art transmission speed and accuracy over short and long distances.

The Concentrator, in turn, uses twisted-pair wire to connect with individual terminals and other devices. It provides multiplex service that connects the workteam or department to the Packet Controller and the company-wide network over the single fiber cable.

The Packet Controller uses a technique known as "perfect scheduling" to avoid data collisions and support speeds of up to 8.64 Mbps. Multiple Packet Controllers may be connected to expand the network. Wide-area connections between buildings may use optical cable or long-haul facilities such as the Digital Data System (DDS) and T1.

2. ISN Interfaces

ISN supports a wide range of interfaces to allow complete connectivity within the organization. Interfaces now available allow communication with the following equipment:

- Asynchronous terminal and host interfaces.
- BSC/SDLC interfaces.
- 3270 synchronous terminal interfaces.
- Interfaces to System 75, 85, and other PBXs.
- High-speed interface to the STARLAN NETWORK.
- Interfaces to other LANs.

3. ISN Interface to STARLAN NETWORKs

For customers who use ISN, two STARLAN Interface Modules (SLIMs) are available to link their PCs into the corporate-wide networking system:

- **SLIM-C (Connection) Module:** Connects the STARLAN NETWORK to the ISN as a regular ISN node. This allows STARLAN NETWORK workstations to use the entire ISN network for access to hosts, modem pools, long-distance transmission lines and other ISN resources.

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- **SLIM-B (Bridge) Module:** Bridges two or more STARLAN NETWORKs via a "virtual circuit" so they appear to be one large network. This allows a STARLAN NETWORK to support additional devices and expand beyond 1600 feet.

The SLIMs are circuit boards that install in slots on the ISN Concentrator or Packet Controller. Exhibit V-12 shows how ISN and STARLAN NETWORKs interconnect.

These options are intended for users who already have, or need, ISN's advanced capabilities. For additional technical information about ISN and the SLIM modules, please refer to Appendix C.

F. STARLAN NETWORK Software

The AT&T STARLAN NETWORK software provides the full range of features and user-friendly interfaces described in this guide. Exhibit V-13 shows at a glance the network services provided by the software for MS-DOS and UNIX System workstations.

1. Software Packages

Several STARLAN NETWORK software packages are available:

- Software for MS-DOS based microcomputers:
  - -- The AT&T PC 6300 Network Program allows the PC to act as both a client and a server.
  - -- An optional electronic mail program provides easy communication among workteam personnel.
- Software for the AT&T UNIX PC:
  - -- The AT&T UNIX PC Network Program allows the PC to communicate with other UNIX-System computers on the network.
  - -- The AT&T UNIX PC DOS Server Program enables the PC to act as a server for MS-DOS workstations.
- Software for the AT&T 3B2 computer:
  - -- The AT&T 3B2 Network Program allows the 3B2 and its workstation terminals to communicate with other UNIX System computers on the network.
  - -- The AT&T 3B2 DOS Server Program enables the 3B2 to act as a server for MS-DOS workstations.

Each workstation must have its own copy of the Network Program. A UNIX PC or 3B2 must also have the DOS Server Program if it is to provide file and print server services to MS-DOS workstations.

2. The MS-DOS Environment

The AT&T PC 6300 Network Program provides file server, print server, client user and administrative support for any MS-DOS workstation.

Every STARLAN NETWORK that includes MS-DOS PCs must have at least one server. However, this does not mean that a separate, dedicated server has to be purchased. Any PC with the minimum memory requirements and a

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EXHIBIT V-12
STARLAN NETWORK Connectivity to ISN

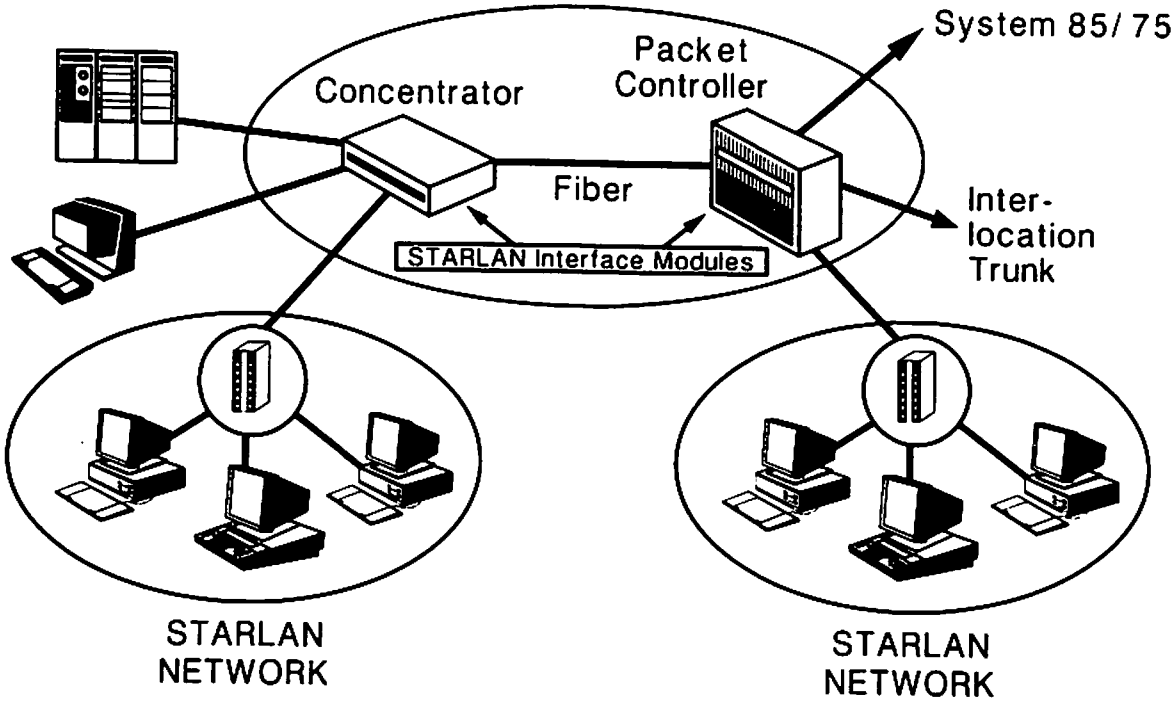

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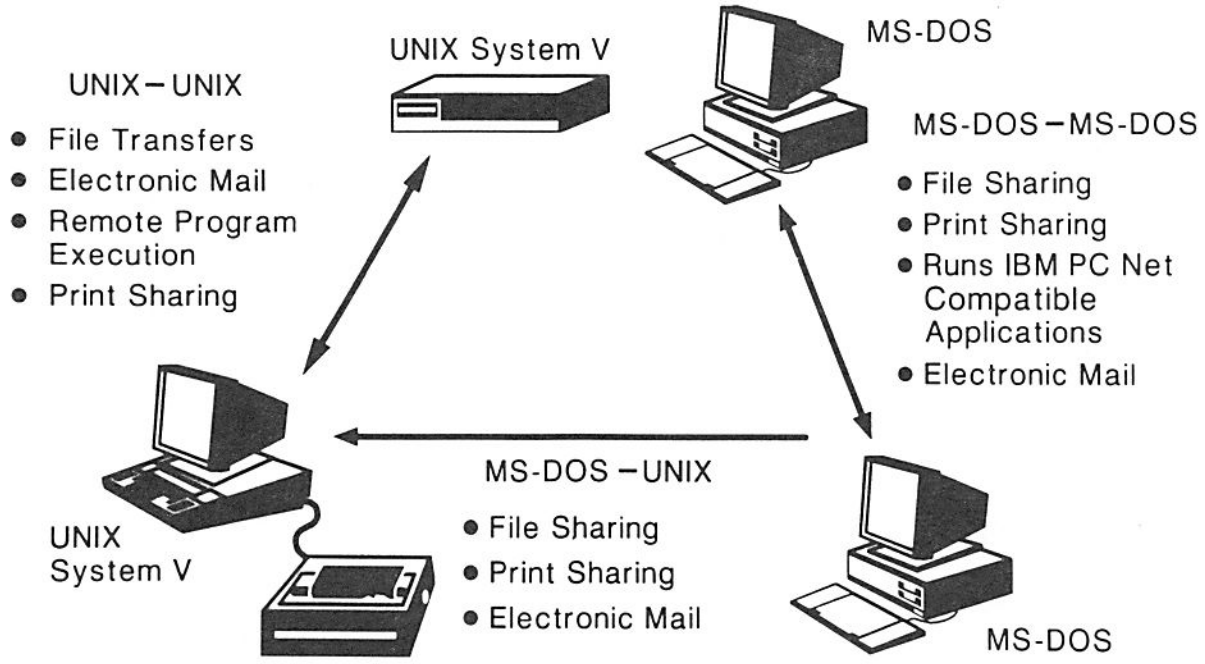
EXHIBIT V-13
STARLAN NETWORK Software Services



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hard disk may act as a server while simultaneously functioning as a workstation -- this is known as a concurrent server.

a. Server Requirements

The number of servers needed on a STARLAN NETWORK depends on the number of MS-DOS workstations, how frequently they use the network, and the amount of disk space required to store programs and data files.

For a small network, one or more workstations may double as concurrent servers. As the network grows, the customer may want the increased performance offered by one or more dedicated servers. There is no maximum limit to the number of devices that may be used as servers.

The Ordering Plan section of this guide offers guidelines for determining a network's server needs. As a general rule, a PC 6300 server can manage file sharing for four to eight MS-DOS workstations; a PC 6300 PLUS server can manage file sharing for six to 12. These numbers will vary according to users' activity and disk storage needs. The number of workstations per print server usually will be limited by the printer speed or location, rather than by the server PC's resources. Ten workstations is a typical load for a print server. There is no need for file sharing and printer sharing to be provided on different servers -- frequently customers will find it convenient for a work group to use one server for both tasks.

It is recommended that every file server have a tape backup mechanism to protect network files.

b. MS-DOS File Services

MS-DOS workstation users may link their PCs to any server on the network. Once linked, the user can access the server's shared disk drives as though they were physically connected to the user's own workstation. The user may assign any DOS drive identifier (D:, E:, etc.) to a directory on the server's disk. Server capabilities include the following:

- A client may connect to two or more servers at one time.
- An MS-DOS machine acting as a server can connect with up to 16 clients at one time.
- Network users can employ any DOS command to copy, delete and otherwise manipulate files on the server's hard disk. They may also make, remove and change directories. The only commands that are not allowed are FORMAT and others that would destroy the disk structure for other users.
- Both network users and the network administrator have the ability to make files available for sharing over the network. They can also make files available to specific users.

c. MS-DOS Printer Support

MS-DOS workstations can share printers and other peripherals that are connected to the server. A spooling buffer (a block of memory inside the

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server PC) holds files waiting to be printed. The line of waiting files is known as the print queue.

The network administrator may assign a different password to each printer on the network to prevent unauthorized use. In addition:

- Users can link to any network printer and assign it a normal DOS print device identifier (PRN:, LPT1:, COM1:, etc.). Once linked, the printer acts as though it were attached directly to the user's workstation.
- Each server can simultaneously support up to three printers (this is a limitation built into MS-DOS).
- To identify different print jobs, the printer can be instructed to print banner heading pages and blank pages between printouts.
- 24 or more print jobs can be queued at one time for a single printer.
- Users may request to print multiple copies of the same file.
- Users can manage the status of their documents in the print queue:
  - -- View the status of jobs in the queue.
  - -- Change the order of their own jobs, or delete their jobs from the queue.
  - -- Defer, hold and release their jobs in the queue.

d. MS-DOS User Capabilities

The following are some of the networking capabilities available to users with MS-DOS workstations:

- Start the network program and log in to their "home directory" (located on one of the network servers) to obtain access to private files.
- Link with other directories and other servers, to access shared files outside the home directory.
- Set up a directory or subdirectory and share it so the files it contains can be accessed by other users on the network. Users can assign passwords to their shared directories, and later "unshare" them. (Users may share or restrict access to their own files, but not to those of other users.)
- Remove the user's own workstation from the network, and reconnect it.
- Obtain information about the resources available on the network, including:
  - -- Shared directories available.
  - -- Printers available.
  - -- Names of other users on the network.
  - -- Print queue status of documents the user has sent to be printed.
- Check the user's current status, including:
  - -- The server(s) in use.

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-- The directory (or directories) currently linked to.

e. Network Administrator Functions

The network administrator has special abilities that allow him or her to set up and maintain the network. The administrator may:

- Create user names and home directories.
- Make directories on the server available so users can share files located in them (although users may permit subdirectories within their own home directories, only the network administrator can permit other home directories).
- Make printers available to network users (and also make them unavailable again).
- Stop and restart printers, servers and workstation links for maintenance, reconfiguration or other purposes.
- Create, change and remove passwords for shared directories and printers.
- Optimize server performance by modifying default configuration parameters such as: number and size of print buffers, number of sessions, open files, shared directories, printer queue entries.
- Manage the print spooler, including the placement of documents (while regular users can control only their own print jobs, the administrator can control all jobs on any printer).

f. Password Security in the MS-DOS Environment

The STARLAN NETWORK protects data against unauthorized access by requiring password entry for access to files and administrative functions. The network administrator can assign different passwords to each shared file directory and each printer. Users can create passwords to protect their own user login names.

Sensitive commands are available to the network administrator only. These include the creation of user names and shared directories, the ability to add and delete users, and the ability to assign file and printer passwords.

Network administrators can further protect files by restricting the types of directory access available to users: read only, write, and create permissions determine whether a user can change a file, create a new one, or merely use the file to obtain information.

g. File Security in the MS-DOS Environment

Whenever multiple users have access to computer files, the question of data security and integrity arises. To protect data from accidental corruption, the STARLAN NETWORK takes advantage of the operating system's built-in file and record locking capabilities.

File and record locking prevent two users from accessing (and trying to change) the same data at the same time. Record locking protects individual database records so more than one user can simultaneously access the same

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database file, as long as they are not trying to use the same record within the file.

h. Electronic Mail Software for MS-DOS Workstations

An optional electronic mail package provides uniform, easy-to-use electronic mail service to MS-DOS PCs. It is installed on one server -- the "mail server" -- which acts as a "post office" for the network. The mail server may also act concurrently as a file and/or print server.

Mail messages conform to CCITT standards for mail message formats. All files are encrypted, and every user has a password to protect mail system privacy.

When a user sends a message, it is stored in the "post office" and waits for the recipient to act on it. If the recipient is logged in to the network, a note appears on his or her screen saying a new message has arrived. If the recipient is not working on the network at the time the message is sent, a note will appear when the user logs in, informing the user that mail is waiting.

The Electronic Mail software has a menu-driven interface that makes it easy for network users to stay in touch. Users may perform the following functions:

- Compose and send short text messages.
- Send computer files alone or attach them to messages.
- Address messages to a particular workstation or group of workstations, or broadcast messages to everybody on the network.
- Mark a message as "registered mail" to receive confirmation when the recipient reads it.
- Sort incoming mail by sender, date, priority, or subject.
- Read messages, edit them, save them, delete them, and/or print them.
- Reply to a message or forward it to another user.

3. UNIX System Environment

The UNIX operating system is designed for multi-user, multi-tasking operations. Because of this, much of the networking functionality is already built-in. Multi-tasking allows UNIX PCs and 3B2s to interact over the STARLAN NETWORK as peers. This means each peer has the ability to run programs, access files, and use peripherals attached to the other. In addition, multi-tasking makes UNIX PCs and 3B2s ideal as servers for MS-DOS workstations.

The network software packages for the UNIX PC and 3B2 provide peer-to-peer communication using the standard UNIX System commands for file transfer, remote program execution, and electronic mail. Users who are already familiar with the UNIX System or with the UNIX PC's menus do not have to learn new commands.

With the STARLAN NETWORK, UNIX System computers gain a fast, inexpensive and convenient way to connect workstations so the existing

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UNIX System functionality can be used to its full advantage. Future releases of the STARLAN NETWORK will support file and record locking for UNIX System devices.

a. UNIX System Networking Functions

UNIX System functions supported by the STARLAN NETWORK include: uucp, uux, and mail. Network services include:

- **File Transfer:** A user at a UNIX System workstation can transfer a file as follows:
  - -- Between local and remote workstations, or . . .
  - -- From one remote station to another.
- **Printer Sharing:** Users may print files and screen printouts on printers attached to other UNIX System machines.
- **Remote Login and Program Execution:** Any UNIX System computer can log in to another UNIX System computer to run programs and access files. As a host, the UNIX PC Model 7300 is recommended for supporting up to three terminal workstations; the Model 3B1 can support up to five terminal workstations.
- **Terminal Emulation:** UNIX PCs and 3B2s can accept remote logins from any workstation on the network that is running a compatible terminal emulation program.
- **Electronic Mail:** Users can send text messages and files to other UNIX System workstations on the network, using the standard UNIX System electronic mail capabilities. The network also supports the UNIX PC's electronic mail package.

b. UNIX System Network Administration

The STARLAN NETWORK administrator can perform the following administrative tasks in the UNIX System environment:

- Enable or disable communication between devices.
- Determine the status of incoming and outgoing communications.
- Specify the maximum number of simultaneous users allowed to log in at a given workstation.
- List system services (such as remote login, or uucp) currently being used on the network.
- Stop a workstation from accepting additional requests -- while allowing it to finish currently-active communications.

To perform the above functions, the administrator must log in with a special name and password. This protects the network from unauthorized changes.

c. File Security in the UNIX System Environment

The STARLAN NETWORK software for the UNIX PC and the 3B2 employs file and record locking, just like the software for MS-DOS. This prevents two users from accessing (and trying to

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change) the same information at once, thereby protecting data integrity.

4. Bridging MS-DOS and UNIX Systems

The STARLAN NETWORK DOS Server Programs for the UNIX PC and 3B2 allow those machines to act as file and printer servers for MS-DOS workstations. A UNIX System computer with this software has the same capabilities as an MS-DOS server. The only difference is that a 3B2 computer can support 32 simultaneous connections (instead of 16).

While acting as a server for MS-DOS workstations, the UNIX PC or 3B2 can still communicate simultaneously as a peer with other UNIX System computers, and also act as a user workstation in its own right. A 3B2 can also concurrently function as a departmental processor for its attached terminals.

a. MS-DOS to UNIX System

In a mixed network, the MS-DOS and UNIX System workstations can share the same files, printers and other peripherals, as long as they are attached to a UNIX System computer running the DOS server software. If the workstations are running UNIX System and MS-DOS versions of the same standard applications software -- such as dBASE III+™ or MS-WORD™ -- they should be able to use the same files.

An MS-DOS workstation may only access network resources that are attached to a server, and a UNIX System workstation may only access resources on other UNIX System devices. Therefore, the way to make a file or printer available to every user is to assign it to a computer that is running both the UNIX System and the STARLAN NETWORK DOS server software.

The present product offerings will not allow a UNIX System workstation to directly access files stored on an MS-DOS workstation; this is easily accommodated by storing all common files on a server that uses the UNIX System.

5. Easy User Interfaces

The STARLAN NETWORK gives users and network administrators access to its capabilities through menus and commands that are fast, easy to learn and easy to use.

a. MS-DOS PC User Interface

Users of the PC 6300, PC 6300 PLUS and other MS-DOS PCs have their choice of methods for entering network commands:

- Multi-window menus let users select commands from the screen. This interface is ideal for new users and for anyone who wants immediate access to networking power without having to learn commands.
- A command-line interface allows more experienced users to bypass the menus and enter commands directly. They can request the network program to prompt them for information, or they can simply enter it at once.

An on-line, context-sensitive help capability is also available.

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b. UNIX PC User Interface

The STARLAN NETWORK commands integrate into the UNIX PC's existing mouse and menu interface. Most activities don't even involve new menu selections -- the user simply selects the same functions in the same place as before, and the STARLAN NETWORK steps in transparently. It helps the user send and receive mail, access remote computers, log in as a terminal, transfer files, or print a file on a printer attached to another workstation.

Experienced users can also exit the menu interface and use standard UNIX System commands to transfer files and access remote equipment.

G. Equipment Configurations

The STARLAN NETWORK is flexible in its support for many different types of workstations, servers, printers and terminals. Just a few requirements must be met for a device to become part of the network.

1. Requirements for Workstations

The requirements for workstations on the STARLAN NETWORK are summarized in Exhibit V-14. Please note:

- The workstation must have enough memory to run the network software and still have room to run applications software.
- An MS-DOS client workstation does not require a hard disk. It can load part of the networking software from diskette and link to a server to obtain access to the remaining network software.
- All PCs and 3B2s must have an expansion slot available for installing the NAU.

2. Requirements for Servers

In order to act as file or print servers on the STARLAN NETWORK, computers must meet the requirements shown in Exhibit V-14. Please note:

- All servers must have at least one hard disk.
- A concurrent server requires more memory than a dedicated server, since it needs memory to run the network software and workstation applications in addition to the server software.
- Just like workstations, a server must have at least one free expansion slot for installing the NAU.

3. Requirements for Printers

The STARLAN NETWORK offers two options for attaching a printer to the network. The printer must be supported by the server computer.

- Connect the printer directly to a file server, using either parallel or serial connections. In a network that involves only UNIX System devices, the printer may be connected to any workstation.
- Connect the printer to an NIU, which supports the direct connection of one or two asynchronous printers.

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EXHIBIT V-14
Workstation and Server Configuration Requirements

	Minimum RAM & Disk Space	Operating System	Network Program	NAU
AT&T PC 6300 & COMPATIBLES		MS-DOS 3.1	AT&T PC 6300 Network Program.	AT&T PC 6300 Network Access Unit.
Client Workstation With Menus	384 KB RAM, or 112 KB plus the minimum RAM recommended for client applications. Floppy or hard disk.			
Without Menus	256 KB RAM, or 96 KB plus the minimum RAM recommended for client applications. Floppy or hard disk.			
Server	512 KB RAM. 10 MB hard disk.			
Concurrent Client/Server	640 KB RAM. 10 MB hard disk.			
AT&T PC 6300 PLUS		MS-DOS 3.1	AT&T PC 6300 Network Program.	AT&T PC 6300 Network Access Unit.
Client Workstation	512 KB RAM. Floppy or hard disk.			
Server	512 KB RAM. 20 MB hard disk.			
Concurrent Client/Server	640 KB RAM. 20 MB hard disk.			
AT&T UNIX PC MODELS 7300 & 3B1	1 MB RAM. 20 MB hard disk for Model 7300. 40 MB hard disk for Model 3B1.	AT&T UNIX PC System Software Version 3.0	AT&T UNIX PC Network Program.	AT&T UNIX PC Network Access Unit.

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4. Requirements for Terminals

An asynchronous terminal may be connected to the STARLAN NETWORK in two ways:

- A terminal attached to a UNIX PC or a 3B2 computer may access the STARLAN NETWORK through the host's Network Access Unit.
- The terminal may be attached to one of the RS232-C ports on an NIU.

The terminal can access network resources including host computers, printers, and connections to ISN. It must be compatible with the 3B2 and/or with the RS232-C interface.

H. Applications Software

AT&T has embarked on an aggressive program to ensure that networked applications are available to run on the AT&T STARLAN NETWORK:

- Software developed for MS-DOS Version 3.1 is compatible with the STARLAN NETWORK, as are most applications written to the NETBIOS interface of the IBM PC Network (also supported on the IBM Token Ring Network). In addition, the STARLAN NETWORK incorporates Microsoft Network's Core Protocols.
- We are working with a number of strategic software vendors to ensure that their networked applications run properly on the STARLAN NETWORK.
- To encourage the development of networked applications for UNIX System based workstations, AT&T has provided Transport Level Interface (TLI), a programming interface for developing custom UNIX System network applications software.
- To facilitate the development of networked applications, AT&T has developed and has available for sale an Applications Programmer's Reference Manual for the STARLAN NETWORK.

At the end of this section, Exhibit V-15 provides a listing of some of the software packages that take advantage of STARLAN NETWORK capabilities. Because of the fluidity of the market, this list may already be outdated. For the most recent listing, see your branch office networking specialist. You will frequently receive updated listings of this software.

I. Compatible Boards

The STARLAN NETWORK is compatible with most PC expansion boards from AT&T and from other vendors. At the end of this section, Exhibit V-15 includes a list of boards that have been tested as compatible with the STARLAN NETWORK. Again, because of the fluidity of the market, this list may already be outdated.

J. Product Rollout Schedule

The STARLAN NETWORK products are being introduced in several phases. This means the network capabilities will be enhanced with each phase of introduction.

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1. Phase 1

During Phase 1, networking will be supported for MS-DOS based workstations and for UNIX PCs. While MS-DOS and UNIX System workstations will be able to coexist on the same network, they will not have the ability to communicate across operating systems. MS-DOS PCs can, however, access UNIX PC hosts via asynchronous terminal emulation.

General availability for Phase 1 will be April, 1986. The hardware and software components for this phase are:

- The AT&T PC 6300 Network Access Unit and the AT&T PC 6300 Network Program, for networking compatible MS-DOS computers.
- The AT&T UNIX PC Network Access Unit and the AT&T UNIX PC Network Program, for networking the UNIX PC.
- The AT&T Network Extension Unit for linking workstations in a star configuration.

2. Phase 2

During Phase 2, MS-DOS and UNIX System computers will be able to share files and peripherals, and MS-DOS workstations will be able to use UNIX System computers as file servers. Phase 2 will also introduce 3B2 networking, ISN compatibility and the ability to link asynchronous devices onto the network via the NIU.

General availability for most Phase 2 components will be third quarter, 1986.

The hardware and software components for this phase are:

- The AT&T 3B2 Network Access Unit and the AT&T 3B2 Network Program, for networking 3B2 computers.
- The AT&T 3B2 DOS Server Program, allowing the 3B2 to act as a file server for MS-DOS PCs.
- The AT&T UNIX PC DOS Server Program, allowing the UNIX PC to act as a file server for MS-DOS PCs.
- The AT&T RS232C Network Interface Unit, for connecting asynchronous devices such as terminals, modems, printers, etc. Initial support will be for terminals only, with later releases supporting other devices.
- The STARLAN Interface Modules for connectivity to ISN (both SLIM-B for bridging networks, and SLIM-C for connectivity with the rest of the ISN network).

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EXHIBIT V-15
Preliminary List of Applications
that Run on the AT&T STARLAN NETWORK
April, 1986

This is a preliminary list of applications and boards that work on the AT&T STARLAN NETWORK. Testing is continuing and updated lists will be provided periodically. Note that products on this list are not necessarily recommended. Some have better features than others, and different customers have different needs and preferences.

It is important to refer to STARLAN NETWORK documentation for guidance when installing applications and boards.

Even when applications do not support remote printing, users can print a spooled job by pressing **ctrl-alt-prtsc**. Notes in the "Comments" column are defined as:

- Single User: Installs on the server, but two users are unable to access the same executable file on a server.
- Client Only: Cannot be installed or executed on the server.

Vendor Application	Comments
Ashton-Tate	
dBASE II Version 2.41	Client Only; cannot access redirector, drives
dBASE III Version 1.1	Client Only; not designed to run on server
dBASE III+ Version 1.0	
AST	
Advantage (AT)	
BSC 3270 Emulator	
Sixpack	
AT&T	
Context Switch for DOS 3.1	Client Only
Memory Expansion Card	
Display Enhancement Card	
Borland International	
Sidekick	
Computer Associates	
Supercalc 3 Version 2.0	

Continued on Next Page

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Vendor Application	Comments
Consumers Software	
The Network Courier	
DCA	
IRMA 3270 Emulator	
DTC	
Hard Disk Controller	
Innovative Software	
Smart	
Lotus	
1-2-3 1, 1A	
1-2-3 2.0	
Symphony 1	
Symphony 1.1	
Micro Data Base Systems	
Knowledgeman2 version 2.00	Single User
Knowledgeman LAN 1.07 version	Single User; Network prints only thru **ctrl-alt-prtsc**
Knowledgeman LAN release 2.00.00	Network prints only thru **ctrl-alt-prtsc**
MicroPro	
Wordstar Version 3.30	
Wordstar Version 3.31	
Microsoft	
Microsoft Basic Compiler Version 2.20	
Microsoft C Compiler	
Microsoft Windows	
Microsoft Word 2.0	Single User on Client PC
Microsoft Word 2.0N	
Mountain Computer	
Mountain Combo Unit	
Multimate	
Multimate Version 3.30	
Multimate Version 3.50	
Multimate Version 1.2	
Peter Norton Computing	
Norton Utilities	
Quadram	
Memory Expansion Card	
Relational Database Systems	
Informix-SQL Version 1.10	Single User
The Software Group	
Enable Version 45.3 (AT&T Co-Labeled version)	

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VI. SUPPORT PLAN

A full range of service and support options are available to STARLAN NETWORK customers, as described below.

A. Installation Assistance

The STARLAN NETWORK can be installed by the customer or by trained AT&T Systems Technicians. Wiring installation options include:

- AT&T installation via PDS:
  - -- Flat rate price list.
  - -- Time-and-materials basis.
  - -- AT&T Premises Service Consultant (PSC) quote.
- Customer installation using standard standalone PDS components. PDS components can be ordered by PECs through DOSS--contact an AT&T-IS representative.

B. Product Warranty

All STARLAN NETWORK hardware and software products carry a 90-day warranty from the date of purchase.

C. Hotline Support

Hotline support is provided during the warranty period at no additional charge. Thereafter, customers may continue this service through maintenance options described below.

D. Maintenance

Maintenance is available both during and after the warranty period.

- During warranty period: Standard maintenance is provided at no additional cost. This consists of Hotline-supported remote maintenance, with onsite repair/replacement or mail-in exchange for defective products.
- Post-warranty period: AT&T offers a range of maintenance options, including:

  Hardware
  - -- Business Day Service (contracted)
  - -- Around-the-Clock Service (contracted)
  - -- Dedicated Service (contracted)
  - -- Mail-In Exchange (contracted)
  - -- Per Occurrence (non-contracted)
  - -- Mail-In Exchange (non-contracted)

  Software
  - -- Remote Only Service (contracted)
  - -- Business Day Service (contracted)
  - -- Around-the-Clock Service (contracted)
  - -- Telephone Hotline Assistance (non-contracted)

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E. Customer Training

The AT&T STARLAN NETWORK Technical Overview course is designed to familiarize decision makers, technical professionals, and management personnel with the capabilities of the STARLAN NETWORK. It is a two-day course taught at the Hickory Ridge Training Center in Lisle, Illinois. The course number is ND3200. To register, call (800) 247-1212.

F. Network Documentation

With the purchase of each STARLAN NETWORK NAU, the customer receives a copy of either of the following user's guides, as appropriate:

- STARLAN NETWORK AT&T Personal Computer 6300 User's and DOS Server Guide.
- STARLAN NETWORK AT&T UNIX PC User's Guide.

The next page contains a list of other AT&T STARLAN NETWORK documentation available to the customer. To order documents, call 1-800-432-6600.

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AT&T STARLAN NETWORK

Marketing Guide

Title	Document No.
AT&T Personal Computer 6300 User's and Administrator's Training Package (Recommended one copy for each network administrator)	999-809-117IS
AT&T UNIX PC User's and Administrator's Training Package (Recommended one copy for each network administrator)	999-809-118IS
Application Programmer's Reference Manual	999-802-215IS
Customer Guide	999-350-001IS
Design Guide	999-809-101IS
Installation and Maintenance Guide Volume 1/Volume 2	780-100-110IS
Introduction	999-809-100IS
Network Access Unit AT&T Personal Computer 6300 Installation Guide	999-809-102IS
Network Access Unit AT&T UNIX PC Installation Guide	999-809-103IS
Network Access Unit AT&T 3B2 Computer Installation Guide	999-809-104IS
Network Extension Unit Installation Guide	999-809-106IS
Technical Reference Manual	999-300-208IS

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VII. ORDERING PLAN

This section will help you determine your client's equipment needs and prepare your STARLAN NETWORK order. The steps to follow are:

- Design the network to accommodate the communication needs and workstation requirements of the customer:
  - -- Determine the workstation requirements.
  - -- Estimate the server requirements.
  - -- Determine the actual layout of the configuration.
  - -- Determine which components are required.
- Fill out the STARLAN NETWORK Configuration Forms (SC Forms) to describe the equipment needed.

A. Designing the STARLAN NETWORK

The STARLAN NETWORK Design Guide (999-809-101 IS) contains all the information you need to configure a network. Refer to it for guidelines and procedures. The tables in this section, taken from the Design Guide, summarize the major considerations in network design.

1. Minimum Workstation Requirements

Exhibit VII-1 shows the minimum requirements for a PC or 3B2 to operate on the STARLAN NETWORK. Each workstation or server requires the STARLAN NETWORK program and a Network Access Unit.

If the customer's current equipment does not meet the memory, disk space or operating system requirements, it may be necessary to recommend the purchase of additional RAM, hard disks, or system software. The customer may also need to consider purchase of additional computers to act as workstations or servers.

2. Server Guidelines

UNIX PCs do not require file or print servers, but a network that contains MS-DOS workstations requires at least one server. Each server may concurrently operate as a workstation, or it may be dedicated to acting only as a server. For file protection, a server should be equipped with a tape backup unit. Guidelines for file server requirements include:

- Estimate the hard disk space required for each user's private files and for spreadsheets, documents, data bases, and other shared network files. As a rule, a typical workstation requires about 5 MB of disk space.
- Decide how much disk space to reserve for adding new users.
- Estimate how frequently users will access the server. As a rule, the server can comfortably support this many workstations at the same time:

PC 6300	4-8
PC 6300 PLUS	6-12

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EXHIBIT VII-1
Workstation/Server Configuration Requirements

	Minimum RAM & Disk Space	Operating System	Network Program	NAU
AT&T PC 6300 & COMPATIBLES		MS-DOS 3.1	AT&T PC 6300 Network Program.	AT&T PC 6300 Network Access Unit.
Client Workstation With Menus	384 KB RAM, or 112 KB plus the minimum RAM recommended for client applications. Floppy or hard disk.			
Without Menus	256 KB RAM, or 96 KB plus the minimum RAM recommended for client applications. Floppy or hard disk.			
Server	512 KB RAM. 10 MB hard disk.			
Concurrent Client/Server	640 KB RAM. 10 MB hard disk.			
AT&T PC 6300 PLUS		MS-DOS 3.1	AT&T PC 6300 Network Program.	AT&T PC 6300 Network Access Unit.
Client Workstation	512 KB RAM. Floppy or hard disk.			
Server	512 KB RAM. 20 MB hard disk.			
Concurrent Client/Server	640 KB RAM. 20 MB hard disk.			
AT&T UNIX PC MODELS 7300 & 3B1	1 MB RAM. 20 MB hard disk for Model 7300. 40 MB hard disk for Model 3B1.	AT&T UNIX PC System Software Version 3.0	AT&T UNIX PC Network Program.	AT&T UNIX PC Network Access Unit.

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EXHIBIT VII-2
NEU Requirements

Number of Direct Connections from PCs and Daisy Chains	Number of NEUs	Recommended Number of Spare IN Jacks
1-10	1	1
11-19	2	2
20-29	3	2
30-39	4	2
40-49	5	2
50-58	6	3
59-68	7	3
69-77	8	4
78-87	9	4
88-97	10	4
98-107	11	4
108-117	12	4

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EXHIBIT VII-3
Maximum Distances -- Daisy Chains Connected to an NEU

MAXIMUM CORD LENGTH FOR A DAISY CHAIN CONNECTED TO AN NEU		
Number of Personal Computers in the Daisy Chain	Maximum Cord Length for 1 NEU	Maximum Cord Length for 2 or more NEUs
1	800 ft. (244 m.)	800 ft. (244 m.)
2	800 ft. (244 m.)	800 ft. (244 m.)
3	800 ft. (244 m.)	800 ft. (244 m.)
4	800 ft. (244 m.)	800 ft. (244 m.)
5	800 ft. (244 m.)	725 ft. (220 m.)
6	725 ft. (221 m.)	625 ft. (191 m.)
7	625 ft. (191 m.)	550 ft. (168 m.)
8	550 ft. (168 m.)	450 ft. (137 m.)
9	450 ft. (137 m.)	400 ft. (122 m.)
10	400 ft. (122 m.)	400 ft. (122 m.)

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- Fill out one copy of SC-1 for each NEU in the network.
- Fill out one copy of SC-2 for each daisy chain in the network.
- Finally, fill out SC-3 to summarize the equipment to be ordered.

Revised forms, which will provide additional information to the service technicians, will be forthcoming and sent under separate cover.

1. Form SC-1 NEU Description

This form describes the devices (or daisy chains) that are attached to each of the 11 in-jacks on the NEU. If the network has more than one NEU, start with the "master" NEU -- the one that connects to all the other NEUs.

At the top of the form, enter the following information about this NEU:

- **NEU Number:** Assign a number to this NEU so it can be easily referenced on the other forms. Even if your network contains only one NEU, other NEUs may be added later.
- **NEU Location:** Give the room number, floor, or other description of the physical location where the NEU will be installed. Be sure to specify if the NEU will be located inside a wiring closet.
- **Master NEU Number:** If this NEU is connected to another "master" NEU, enter that NEU's number here. The "master" NEU is the only NEU in a network that can connect to more than one other NEU.

Now fill out the following information for each in-jack on the NEU:

- **Use of In-Jack:** Place a check mark next to the type of device/system attached to this in-jack. If no device is attached to this jack, write "none."
  - -- NEU (enter a number to identify the NEU and fill out another SC-1 Form for this NEU).
  - -- Daisy Chain (fill out an SC-2 Form for this daisy chain).
  - -- Single Station (continue filling out the remainder of this form).
- **Type of Workstation:** Write in the model name of the workstation, e.g.:
  - -- PC 6300
  - -- PC 6300 PLUS
  - -- UNIX PC 7300
  - -- UNIX PC 3B1
  - -- 3B2
  - -- IBM PC
  - -- Etc.
- **Mode:** Indicate how the workstation will be used:
  - -- S=Server only.
  - -- U=User workstation.
  - -- SU=Concurrent server/workstation.
- **RAM:** Enter the amount of random-access memory (512KB, 640KB, etc.).
- **Hard Disk:** Enter the size of the hard disk (e.g., 10 MB). If there is no hard disk, write "none."

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- **Op System:** Describe the operating system and its version number (e.g., PC DOS 3.21, UNIX System 3, etc.).

- **Slot:** Enter the slot number where the NAU will be installed on this workstation.

- **Options:** For MS-DOS workstations only, describe the option settings for the PC 6300 NAU. If the normal settings are used, enter "D" for default.

- **Station Name:** For a UNIX PC, or if the workstation will not be used as a server, enter here the name that will be assigned to it on the network (e.g., "USER2," "GEORGE," etc.). If the workstation will be used as a Server, leave blank.

- **Server Name:** Do not enter anything for a UNIX PC. For an MS-DOS PC, enter one of the following:

  -- If the workstation is used as a dedicated or concurrent server, enter the name that will be assigned to it on the network.

  -- If the workstation is not a server, enter the name of the server associated with it.

- **Printer ID:** Enter the names of any printers attached to this workstation.

- **Location:** Enter the room number, floor, or other description of the physical location where this workstation is or will be installed.

- Finally, total the number of workstation entries for both MS-DOS and UNIX systems.

2. Form SC-2 Daisy Chain Configuration

This form describes the devices on a daisy chain. If your network contains more than one chain (as in an extended star configuration), fill out one copy of the SC-2 for each chain.

At the top of the form, enter the following information about this chain:

- **Daisy Chain Number:** Assign a number to this chain so it can be easily referenced on the other forms. Even if your network contains only one chain, others may be added later.

- **NEU Number:** If the chain is attached to an NEU, enter the number that identifies the NEU and also enter the following information:

  -- **NEU In-Jack Number:** Enter the number of the in-jack where the chain is attached.

  -- **Master NEU Number:** If the NEU is attached to another "master" NEU, enter the master NEU's number.

  -- **NEU Location:** Enter the room number, floor, or other description of the physical location where the NEUs are installed. For a closet star, specify that the NEU is located in a wiring closet.

Now fill out the following information for each workstation, server, NIU or other device on the chain:

- **Distance:** For the first workstation, enter the distance, in cable feet, from that workstation to the NEU. For the

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second and subsequent workstations, enter the distance between it and the preceding workstation.

- **Type of Workstation:** Write in the model name of the workstation, e.g.:
  - -- PC 6300
  - -- PC 6300 PLUS
  - -- UNIX PC 7300
  - -- UNIX PC 3B1
  - -- 3B2
  - -- IBM PC
  - -- Etc.
- **Mode:** Indicate how the workstation will be used:
  - -- S=Server only.
  - -- U=User workstation.
  - -- SU=Concurrent server/workstation.
- **RAM:** Enter the amount of random-access memory (512KB, 640KB, etc.).
- **Hard Disk:** Enter the size of the hard disk (e.g., 10 MB). If there is no hard disk, write "none."
- **Op System:** Describe the operating system and its version number (e.g., PC DOS 3.21, UNIX System 3, etc.).
- **Slot:** Enter the slot number where the NAU will be installed on this workstation.
- **Options:** For MS-DOS workstations only, describe the option settings for the PC 6300 NAU. If the normal settings are used, enter "D" for default.
- **Station Name:** For a UNIX PC, or if the workstation will not be used as a server, enter here the name that will be assigned to it on the network (e.g., "USER2," "GEORGE," etc.). If the workstation will be used as a server, leave blank.
- **Server Name:** Do not enter anything for a UNIX PC. For an MS-DOS workstation, enter one of the following:
  - -- If the workstation is used as a dedicated or concurrent server, enter the name that will be assigned to it on the network.
  - -- If the workstation is not a server, enter the name of the server associated with it.
- **Printer ID:** Enter the names of any printers attached to this workstation.
- **Location:** Enter the room number, floor, or other description of the physical location where this workstation is or will be installed.
- Finally, summarize the total distance of the chain (in cable feet) and the total number of workstations (both MS-DOS and UNIX System).

3. Form SC-3 Ordering Worksheet

Fill out SC-3 when you have finished all the other forms. It summarizes your customer's requirements for hardware components, networking and operating system software, and wiring. For each item on the form, enter the quantity required.

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For more guidelines on the selection of wiring cords and adapters, please refer to the STARLAN NETWORK Design Guide.

C. Additional Questions

Before placing your order, ask the following questions:

- What maintenance coverage does the customer want?
- Who will install the network hardware and software?
- Is it necessary to install new wiring and, if so, who will do the installation?
- Who are the customer personnel responsible for network administration and technical support?
- Does the customer need training assistance for technical personnel, network administrators, or end users?

D. Price Element Codes

Exhibit VII-4 shows the PECs to be used when ordering STARLAN NETWORK components.

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EXHIBIT VII-4
PE Codes

Price Element Codes

PE Code	Description
AT&T STARLAN NETWORK Access Unit	
2614-100	AT&T PC 6300 NAU Package
2614-200	AT&T UNIX PC NAU Package
AT&T Network Extension Unit	
2610-001	NEU Package
Software Packages	
1020-S01	AT&T PC 6300 Network Program
1030-S01	AT&T UNIX PC Network Program

Modular Cords

For an AT&T PC 6300 or a compatible computer equipped with an AT&T Communications Manager card, use the short modular cord (listed below) to connect the card to the NAU.

For an AT&T UNIX PC Model 7300 or Model 3B1, use the short modular cord (listed below) to connect a LINE jack to the NAU.

PE Code	Description
2725-40B	D4BU: 2 ft.

Continued on Next Page

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EXHIBIT VII-4 (Continued)
PE Codes

Select among the following modular cords to connect workstations in a Daisy Chain or directly to a hub:

Cord Length (ft.)	DW8A-DE Standard Modular Cord* PE Code	DP8B-DE Plenum Modular Cord** PE Code
10	2725-29K	2725-32K
25	2725-29S	2725-32S
50	2725-29V	2725-32V
75	2725-29Y	2725-32Y
100	2725-29Z	2725-32Z
150	2725-30X	2725-33X
200	2725-34X	2725-34X

* 4-pair, 24-gauge PVC satin silver double-ended modular cord.
** 4-pair, 24-gauge plenum satin silver double-ended modular cord.

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Appendix A: Technical Introduction to Local Area Networking

Appendix B: Technical Specifications

Appendix C: STARLAN NETWORK Interface Modules for ISN

Appendix D: Glossary of Useful Terms

APPENDIX A: A TECHNICAL INTRODUCTION TO LOCAL AREA NETWORKING

The primary function of a PC local area network like the STARLAN NETWORK is to connect intelligent workstations that are of similar size and processing capability. The term "local area" means the network operates among devices that are placed relatively close to each other -- within a thousand or so feet and usually within the same building.

Every device -- workstations, servers, terminals, etc. -- has a unique address and is said to be a "node" on the network. Nodes communicate with each other by sending electrical signals along the transmission medium. Network hardware components supply the physical connections for the wires, and network hardware and software translate the signals into a form the computer can use and provide a user interface for entering network commands.

Thus, a PC LAN has three major components:

- Transmission medium.
- Hardware.
- Software.

Many vendors do not sell all of the PC LAN components. AT&T's STARLAN NETWORK product offerings include both hardware and software. The AT&T Premises Distribution System (PDS) provides the transmission medium, although the STARLAN NETWORK can also use most other 24-gauge twisted-pair wiring schemes.

A. The "Hidden" Network

Parts of a PC LAN are immediately visible: the computers, the wires, the networking hardware (NAUs, NIUs and NEUs in a STARLAN NETWORK), the prompts and commands displayed on the workstation's screen by the network software user interface. However, the major work of the network is invisible. Every node must perform these functions:

- Translate commands, files, and other information into electrical signals for transmission, and vice versa when a message is received.
- Send transmissions, labeling each message with the network address of the node(s) that should receive the message.
- Detect and receive messages that are addressed to it.
- Ascertain that messages are sent and received accurately, which means avoiding "collisions" with other transmissions being sent at the same time.

Various types of LANs perform these functions in different ways. The techniques they use determine how well the network functions for its users. The rest of this appendix describes how LANs, including the STARLAN NETWORK, meet the challenge of creating and controlling traffic on the network.

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1. Sending Out Transmissions

There are three basic methods for sending messages between two devices on a network:

- **Point-to-point connection**: A single communications link exists between every two devices, so there is a dedicated communication channel between them at all times.
- **Multipoint connection**: Several devices share the same link, but only one device can transmit at a time.
- **Broadcast connection**: The message is transmitted to every device on the network, but each device acts only upon messages addressed to it.

Most PC LANs, including the STARLAN NETWORK, use the broadcasting method as a first step in establishing a connection between devices.

2. Establishing Connections

STARLAN NETWORK nodes can address a message to one particular device or to a group of devices, or they can send a message to all devices on the network.

When the sender begins to broadcast a message across the network, the message contains the logical name of the intended recipient(s). Every other device on the network receives the message and checks to see if the logical name matches one of its own recognized names. If not, the message is disregarded.

When the message arrives at a device that recognizes the logical name, the recipient broadcasts a message back to the sender, giving the sender its physical network address. This information allows the sender to set up a virtual circuit between itself and the recipient, for transferring data.

3. Data Signals

The STARLAN NETWORK sends information in a digital format, transmitting a sequence of ones and zeros across the network wires. When there are no messages being transmitted, the wires carry no voltage.

When signals are sent, they follow a standard technique known as "Manchester encoding." A "zero" is indicated by a brief positive-voltage signal (pulse) followed by a negative-voltage pulse. A "one" is indicated by a negative pulse followed by a positive pulse. These pulses are grouped into packets of information known as "frames."

4. Frame Contents

On the STARLAN NETWORK, a "frame" may contain about 64 to 1500 characters. The first 48 characters contain the address of the node to which the message is being sent. The rest of the message may contain instructions ("print this"), files (programs or data), or a combination of these.

The job of breaking a message into frames and attaching an address belongs to the network hardware (specifically, the NAU and NIU) and associated software. The way signals travel over a

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LAN's wires depends on the transmission medium in use.

B. Transmission Media

A number of key technological choices are involved when designing -- or deciding to purchase -- a network. The most basic decision is what kind of medium to use for carrying network transmissions. This decision shapes all other design factors. Increasingly, manufacturers are turning to twisted-pair wiring for PC LANs -- including IBM, which used broadband cabling for its PC Network LAN but now offers limited support for twisted-pair wire on its Token Ring Network.

Twisted-pair wiring is the type of wiring for which AT&T's STARLAN NETWORK was designed. The discussion below provides a detailed description of the various wiring and cabling options available today, and explains why twisted-pair wiring is the right choice for the STARLAN NETWORK and its users.

1. Broadband versus Baseband

The first decision is whether to use broadband or baseband transmission. The terms "broad" and "base" refer to the bandwidth of the transmission. A wider bandwidth allows the transmission of a higher-frequency signal. A sufficiently broad bandwidth can be divided into several frequencies and thus carry more than one signal channel at once.

Typically, voice transmission requires a bandwidth of 3000 to 4000 cycles per second (3 to 4 kHz). A TV channel occupies a bandwidth of 6 million cycles per second (6 MHz). LAN data transmissions can be designed for a wide range of bandwidths, depending on the chosen transmission medium.

a. Baseband Transmissions

A baseband medium, including twisted-pair wire and baseband coaxial cable, provides one channel. A baseband network can still send more than one signal at roughly the same time, but it does so through timing divisions and not by sending parallel signals. The major disadvantages are that baseband networks, although more than adequate for PC traffic, are slower and limited in distance. Another disadvantage is that the same cabling cannot be used for other transmissions.

The advantages are that a baseband network can use relatively inexpensive and easy to install twisted-pair wiring or regular coaxial cable. The typical PC LAN's requirements are well within baseband's speed and distance limitations.

b. Broadband Transmissions

A broadband network, suitable for large-scale integration of devices other than PCs, uses CATV cabling, the same medium used for transmitting cable television signals. The cable has a bandwidth of almost 400 MHz, and the network may divide the bandwidth into multiple channels. Thus, a broadband network can carry more than one signal at once. Typically, a broadband cable carries several discrete channels, one or more of which can be used for the PC LAN.

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Broadband cabling has advantages for certain applications. The same system may be used for simultaneous voice, data and video transmissions. Broadband supports large distances (about 50 miles) and high speeds. The components are reliable and maintenance is not difficult.

The major disadvantage, however, is cost. In addition to the extra cost for the cabling itself, broadband networks use more sophisticated and therefore more expensive communications devices. There is no need to incur the expense and installation difficulties of broadband technology if the extra capabilities are not needed. PC local area networking is not itself sufficient reason to use broadband technology. For these reasons, the STARLAN NETWORK uses the baseband method.

2. Wiring/Cabling Approaches

A network can use unbounded media such as radio waves, microwaves, and infrared transmissions. However, most PC LANs use bounded media, including twisted-pair wire, broadband and baseband coaxial cable, and fiber optic cable.

a. Twisted-Pair Wire

Unshielded twisted-pair wiring is used in most PBX and telephone systems. It is the simplest medium to install and the least expensive.

In general, twisted-pair has a narrow signal channel and is not reliable over extremely long distances at extremely high speeds. This restricts the distance and speed of the network and limits the number of devices that can be supported; generally, the faster the speed, the shorter the reliable distance. However, STARLAN NETWORK transmissions over twisted pair have tested reliably at distances of up to 800 feet at a speed of 1 Mbps -- more than adequate for nearly all PC installations.

One of the design objectives for the STARLAN NETWORK was the ability to use existing telephone wire -- i.e., unshielded cable. The use of shielded twisted pair may allow higher speed and greater distance, but at a greater cost. Although distance and performance parameters are not available for the STARLAN NETWORK over shielded twisted pair, nothing in the network design prohibits the use of shielded cable. Note, however, that AT&T studies have shown that 95% of all workstations are located within 200 feet of a wiring closet, and nearly 99% of all workstations are located within 800 feet. Therefore we have found the distance supported by unshielded cable to be appropriate for the vast majority of customers.

b. Coaxial Cable Systems

Coaxial cable is more expensive and less convenient to install than twisted-pair. The advantage is its ability to support faster speeds and longer distances. A coaxial network can span nearby buildings and operate at up to 50 Mbps depending on the network design.

The cable used in baseband and broadband systems is the same; the attached electronics make the difference. Broadband transmissions require complex RF (Radio Frequency) modems. The bandwidth is split so that half is used for transmission and the other half for

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reception. Unlike baseband cabling media, a broadband system uses power supplied by special equipment, rather than simply drawing power from the devices attached to the network. Installation of a broadband system is expensive and difficult. However, this medium offers all the advantages of broadband transmission.

c. Fiber Optic Cable

Fiber optics offers the fastest speed and greatest distance of any cabling method. A fiber optic cable contains fibers that carry light waves generated by lasers or light-emitting diodes. Speeds of over 50 Mbps can be sustained over more than six miles, without using repeaters.

Optical fibers have a central core of glass or plastic with a high index of refraction. This is surrounded by a layer with a slightly lower refractive index. Light waves travel down the central core, reflected back into place whenever they strike the lower-refracting coating.

Fiber optic technology is still expensive. Installation is difficult and requires highly skilled technicians. However, it is the state of the art for heavy traffic, long-distance networking. That's why the AT&T Information Systems Network (ISN) uses fiber-optic cable as one of its transmission media. Users of the STARLAN NETWORK can link to ISN if they need the special capabilities of fiber-optic communication.

C. Network Topologies

Every device on the network is connected by wire to every other device. The way devices interrelate over the physical connections is known as the network "topology." The topology has implications for the network hardware and software design.

There are three common LAN topologies: star, ring and bus. The topology is not always a function of how the network looks -- the STARLAN NETWORK can be connected into either a daisy chain or a "star" design, but the network uses a bus topology and not a star topology. That's because the network functions are performed by individual workstations, as on a bus, and not by the central hub of the star.

1. Star/Hierarchical Topology

In a true star topology, every device connects to the same central node, or "hub," which controls network communications. There are two methods for creating a virtual circuit between the sender and the receiver:

- Circuit switching: the hub establishes a link between the sender and receiver on demand, allowing them exclusive use of the circuit until the transmission is completed. Modern PBX systems use this approach.
- Message switching: the hub transmits the entire message to an intermediate point (the switching computer), stores the message for a period of time, and then transmits it to the destination. This method is typical of networks that contain a number of stars, when

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the hub of one star has the ability to communicate with the hub of other stars.

The STARLAN NETWORK does not have a star topology because the NEU does not perform either of these functions. The NEU is a non-switching device that merely allows workstations to establish their own connections.

The true star topology is useful for connecting devices when it is important to make the devices inexpensive (for example, the telephones on a PBX system). However, the true star requires a complicated and expensive central hub for even the most simple network configurations (e.g., connecting only two workstations). This makes a true star impractical for a network that is intended to be inexpensive at the entry level.

Another disadvantage of the true star is that the entire network is shut down if the central hub fails.

2. Ring/Loop Topology

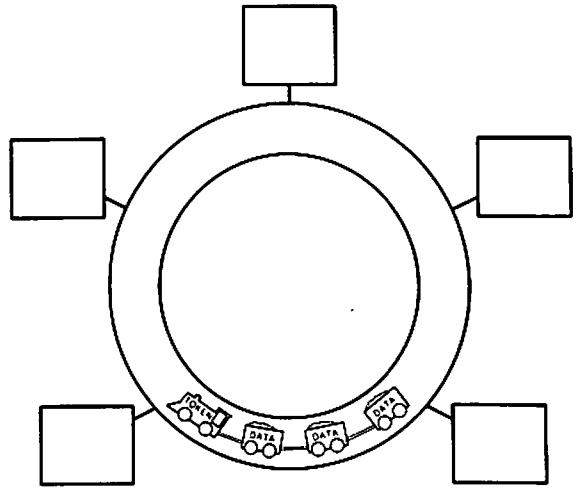
In a ring configuration, devices are connected by wire or cable to form a closed circular loop. The devices continuously transmit a "control token" signal that circles around the network. Only the device that currently has the token is allowed to send a message.

Transmissions on the ring may be either full-duplex or unidirectional:

- Full-duplex: the sender transmits in either direction, and messages pass through all devices between the sender and the receiver.
- Unidirectional: all messages travel in the same direction around the ring. A message travels until it is received at the addressed device, or returns to the sender. Each intervening device reads the address, acts on the message if addressed to it, repeats it, and sends it on to the next device.

Unidirectional topologies are simpler to design and implement. Message routing is simpler since only one direction is possible. Since the message travels to every device on the ring, the sender needs to know the receiver's identifying name, but does not need to know the receiver's location. Also, unidirectional transmission is faster since more than one message can be on the ring at once. Exhibit A-1 illustrates a ring topology.

EXHIBIT A-1
Ring/Loop Topology



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The IBM Token Ring Network uses this topology and also uses the Token Ring protocol, which is described later in this section. The Token Ring Network is actually a "star-wired ring" because each device connects separately to the ring, instead of the ring passing directly through the devices. The advantage of this is that a device can fail or be disconnected without breaking the ring.

3. Bus Topologies

In a bus topology, the devices connect to a central cable that does not form a closed loop. On a STARLAN NETWORK, the bus may be the Daisy Chain wires, or it may be the wires that lead into and out of the NEU. Individual devices send messages out onto the bus where they travel to other devices. No central switch is required, and the network is only active when actual messages are being transmitted. A bus topology is illustrated in Exhibit A-2.

The STARLAN NETWORK in a star configuration is a "star-wired bus" since each device connects separately to the bus, instead of the bus passing through the devices. If one network device fails or is disconnected, the STARLAN NETWORK bus remains intact and the rest of the network is not affected. This is true of all configurations except the daisy chain.

There are a number of ways to regulate traffic on the bus. A centralized controller can handle all processing, but most PC LANs instead use decentralized controllers installed in each device on the network. The STARLAN NETWORK is decentralized, giving control to the NAUs and NIUs.

The bus topology is popular largely because of its use in Xerox's Ethernet and similar popular LAN products. The performance and reliability depend on the transmission medium, the number of devices, the protocols and control methods used, and the amount of traffic. One advantage of the bus topology is that it is simple to implement. Another is that it uses a single cable to run throughout a location and is therefore easy to tap into.

The STARLAN NETWORK, Ethernet, and many other popular bus networks use the CSMA/CD protocol to control traffic on the network. CSMA/CD is described below.

D. Standard Protocols

The computer industry has a number of organizations that work to establish standards to ensure compatibility between devices made by different vendors. One of these is the Institute of Electrical and Electronic Engineers (IEEE). The IEEE's 802 Committee has developed a number of standards for local area networking, including the following:

- 802.2 Data Link Layer.
- 802.3 CSMA Protocol.
- 802.4 Token Bus Protocol.
- 802.5 Token Ring Protocol.

Most networks designed to the 802 standard use the 802.2 Data Link Layer and one of the three remaining Media

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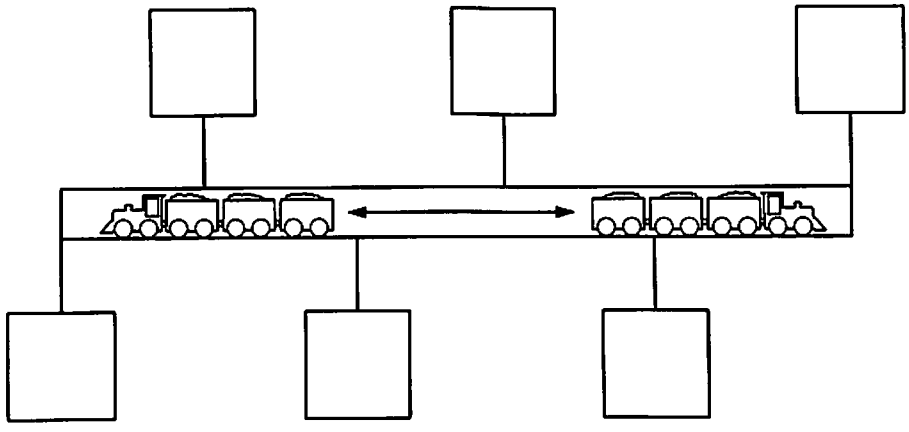
EXHIBIT A-2
Bus Topology



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Access Layer protocols. The choice of protocol depends on the network topology and on the type of communication for which the network will be used most often.

a. CSMA/CD Protocol

CSMA/CD is optimized for intermittent network traffic, as opposed to constant communication between devices. Although devices only transmit when they have something to say, all devices continually "listen" for transmissions addressed to them. At any one time, the network transmission channel can be in one of three states:

- Idle (no transmissions).
- Transmission.
- Contention (more than one transmission competing for the channel).

When a device attempts to send a message, it first checks to make sure that the network is idle (i.e., no other transmissions are in process). Then it broadcasts the information, with the address of the recipient. The sender continues to transmit while listening for the message to be echoed back. If the echoed transmission contains errors, the sender assumes that there has been a "collision" with data being transmitted from other devices.

On a STARLAN NETWORK star configuration, the NEU provides additional collision detection. The NEU monitors traffic on its "in" jacks -- if more than one port is active, that means more than one device is trying to transmit. The NEU sends out a "collision present" signal that notifies all devices on the network that a collision has occurred.

When a collision occurs, all senders stop transmitting and wait a random amount of time before trying to transmit again. Since each "colliding" sender uses a random waiting period, they are unlikely to collide a second time. If they do, they try again.

CSMA/CD operates best over a limited distance; otherwise the sender has to wait too long to receive confirmation from the receiver. Also, it can slow down in conditions of heavy traffic when collisions occur very frequently. Fortunately, however, neither of these conditions is often found in PC LAN environments of the type for which the STARLAN NETWORK was designed.

b. Token Protocols

The token ring or token bus protocols are used with the appropriate network topologies.

A "token" packet of data continually travels along the bus or ring, transmitted between network devices. Whenever the token reaches a device, the device checks to see if the token is empty or if it contains a message. If the token is empty, the device may use it to send a message.

If the token is full, the device checks to see if the message is addressed to it. If not, the device sends the token on to the next device unchanged.

When the message arrives at its destination, the device acts on the message and marks the message to indicate that it has been received. Then the message

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continues through the ring or bus until it reaches the sender. The sender reads that the message was received and resets the token to read "empty."

A device that needs to transmit data merely waits for an empty token.

The token protocols allow heavy-traffic transmission because there is no danger of collision. However, there is a fair amount of processing overhead involved in the constant communication required to pass tokens. This overhead requires network designers to make components that can stand up to the constant use, and the overhead can delay the sending of actual messages.

Token protocols are best suited for high-traffic networks in which collisions would be frequent and communication is nearly constant anyway. They are also suited for networks that require a larger distance than CSMA/CD can support. Neither of these conditions applies for a PC LAN like the STARLAN NETWORK.

E. The ISO Reference Model

The two protocols described above were developed by the IEEE to fit into an overall model of network communication that was developed by the International Standards Organization (ISO). The ISO Reference Model describes seven levels of network compatibility. When network designers speak of network software and hardware, they often refer to the ISO layers illustrated in Exhibit A-3. The standards are written for the interfaces between layers and for the procedures used by each layer.

Layer 1 -- Physical

Layer 1 describes the physical link between devices and the network transmission medium. It governs the physical, electrical, functional, and procedural aspects of establishing and maintaining connections. Examples include the connections between a terminal, its network access hardware (e.g., NAU) and the network wiring. Other Layer-1 concerns include electrical interface questions: voltage levels, pulse lengths, etc.

For example, the STARLAN NETWORK uses the EIA RS422 balanced electrical characteristics, with Manchester Encoding for the electrical signals.

Layer 2 -- Link Control

Layer 2 governs the sending of data over a physical link. This is the layer defined by the IEEE 802 standard. Layer 2 is usually divided into two sub-levels:

- The Media Access Control (MAC) Layer provides control for accessing the communications bus and also supports error detection. CSMA/CD is the MAC standard used by the STARLAN NETWORK.

- The Logical Link Control (LLC) Layer includes two types of data link control operation. Type 1 provides a data link connectionless service with minimum protocol complexity. Type 2 provides a data link connection-oriented service comparable to existing data link control procedures (e.g., ADCCP or HDLC). The STARLAN NETWORK uses the IEEE 802.2 Type 1 LLC Standard.

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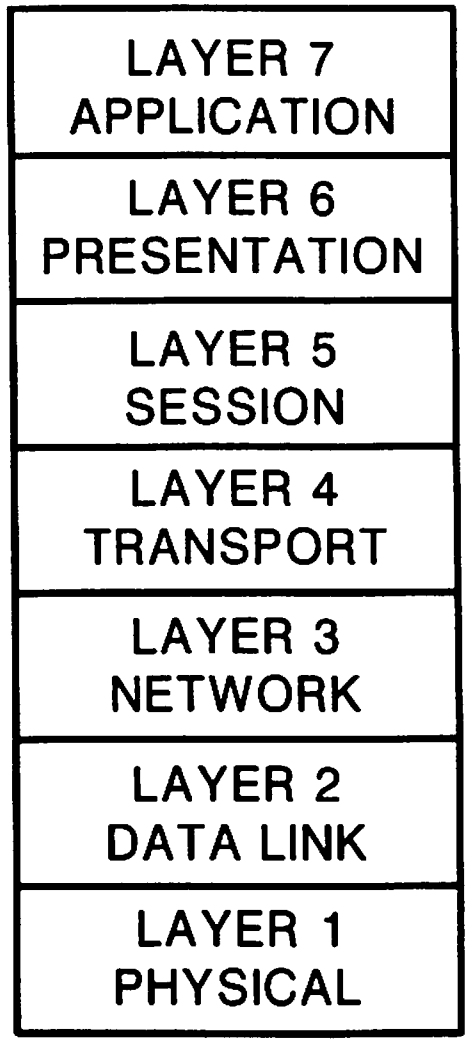
EXHIBIT A-3
ISO Architectural Reference Model



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Layer 3 -- Network

Layer 3 governs the addressing of messages and the establishment of virtual circuits between devices. This is a null layer in the STARLAN NETWORK; that is, the standards for the surrounding layers take this layer into consideration.

Layer 4 -- Transport

Layer 4 concerns the connection of devices -- including multiplexing through virtual circuits and error and flow control. The STARLAN NETWORK employs the same protocol as ISN: an eight-bit version of the Universal Receiver Protocol (URP) is used, together with call control and datagram functions.

Layer 5 -- Session

Layer 5 establishes, maintains, and terminates a dialog session between two users. It regulates which user transmits and for how long, how interrupts are handled, and in what order transmission takes place. For this layer, the STARLAN NETWORK uses the Microsoft Networks session protocols (in the MS-DOS environment).

Layer 6 -- Presentation

Layer 6 governs the transformation of data into a form usable by the application layer (Layer 7). This includes turning data bits into a readable display or printout. Other Layer-6 functions include data encryption and decryption, data compaction and expansion, and code conversion.

There is no distinction in the STARLAN NETWORK architecture between Layer 6 and Layer 7.

Layer 7 -- Application

Layer 7 concerns the higher-level functions that support system activities such as file transfer control, distributed data base activities, and operator support. These include timesharing transactions and delivery of transactions in time-share sequence. Other examples include remote job entry and electronic mail as well as the user's applications such as spreadsheets, data base programs, word processors and vertical applications.

For MS-DOS file sharing, the STARLAN NETWORK uses the Microsoft Networks Redirector software and MS-DOS version 3.1. For UNIX System operations, it uses uucp, the standard file transfer method for the UNIX System.

For more information about the STARLAN NETWORK implementation of these protocols in each of the operating system environments, please refer to Appendix B.

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APPENDIX B: TECHNICAL SPECIFICATIONS

This appendix provides more detailed and technical information about the STARLAN NETWORK, including the network hardware, wiring, transmission protocols, and software.

The STARLAN NETWORK supports an open architecture. AT&T is providing vendors with the interfaces, boards, documentation, etc., necessary to develop products that are fully compatible with the STARLAN NETWORK.

The STARLAN NETWORK uses a proprietary protocol, the Universal Receiver Protocol (URP), at the network and transport levels to provide full compatibility with ISN. While this protocol is proprietary, interfaces are fully documented. Other software protocols are industry standards; please see the software discussion below for details.

A. Network Hardware

The hardware components of a STARLAN NETWORK include the Network Access Units, Network Interface Units, and Network Extension Units. Exhibits B-1 and B-2 summarize the specifications for each component.

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EXHIBIT B-1
STARLAN NETWORK Access Unit Specifications

	AT&T PC 6300 and Compatibles Network Access Unit	AT&T UNIX PC Network Access Unit
DIMENSIONS	Occupies a single full-sized expansion slot	Occupies a single expansion slot
POWER REQUIREMENTS	+5.0 Vdc, 1.0A -5.0 Vdc, 0.03A	+5.0 Vdc, 1.0A -5.0 Vdc, 0.05A
STORAGE ENVIRONMENT	-40 to 60 degrees Centigrade -40 to 140 degrees Fahrenheit 8% to 95% humidity, non-condensing 0 to 30,000 feet altitude 0 to 9 kilometers altitude	-40 to 60 degrees Centigrade -40 to 140 degrees Fahrenheit 5% to 95% humidity, non-condensing 0 to 30,000 feet altitude 0 to 9 kilometers altitude
OPERATING ENVIRONMENT	0 to 40 degrees Centigrade 32 to 104 degrees Fahrenheit 8% to 80% humidity, non-condensing 0 to 10,000 feet altitude 0 to 3 kilometers altitude	0 to 40 degrees Centigrade 32 to 104 degrees Fahrenheit 20% to 80% humidity, non-condensing 0 to 10,000 feet altitude 0 to 3 kilometers altitude
FCC COMPLIANCE	Complies with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules.	Complies with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules.
OPTIONS	**Interrupt request:** 2, 3, 4, 7 **I/O Address:** 360 to 367, 368 to 36F **RAM Address:** 80000 to E0000	

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EXHIBIT B-2
STARLAN NETWORK Extension Unit Specifications

	Network Extension Unit
MODULAR JACK PORTS	11 IN jacks for connecting devices 1 OUT jack for connecting to a Master NEU
DIMENSIONS	12 in. high x 2.5 in. wide x 6 in. deep (30 cm. x 6 cm. x 15 cm.) Allow 20 sq. in. (129 sq. cm), to provide room for modular cords
POWER REQUIREMENTS	105 to 130 VAC, 60 Hz, 8 watts
POWER UNIT U.L. LISTING	Plug-in Class 2
CSA CERTIFIED	Yes
STORAGE ENVIRONMENT	-40 to 60 degrees Centigrade -40 to 140 degrees Fahrenheit 5% to 95% humidity, non-condensing 0 to 30,000 feet altitude 0 to 9 kilometers altitude
OPERATING ENVIRONMENT	0 to 50 degrees Centigrade 32 to 122 degrees Fahrenheit 5% to 95% humidity, non-condensing 0 to 10,000 feet altitude 0 to 3 kilometers altitude
FCC COMPLIANCE	Complies with the limits for Class A computing device pursuant to Subpart J of Part 15 of FCC Rules.

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1. Network Access Unit (NAU)

A Network Access Unit (NAU) is installed in each supported workstation or processor to provide connectivity to the STARLAN NETWORK. The NAU is a printed circuit board that plugs into one of the computer's expansion slots. On IBM ATs and other computers with slots of varying sizes, the NAU fits in full-size slots only.

Each NAU has a unique physical address. The NAU provides network access, network termination, data link control, collision detection, and other networking functions. It is powered by an Intel 82586 microprocessing chip, which performs the following functions:

- CSMA/CD data link functions (leaving the host CPU free to perform other processing).
- Supports established and emerging IEEE standard protocols.
- Provides on-chip memory management (PC 6300 NAU only).
- Network diagnostics.
- Self-test diagnostics.

The NAU draws its power from the PC. Exhibit B-3 is a functional diagram of the NAU.

a. NAU Connectors

Each NAU provides the following three connectors, all using eight-pin modular jacks:

- **IN Connector:** In a daisy chain, the IN jack connects the NAU to the next "downstream" device. It provides contacts that connect a "characteristic impedance" device to the transmit and receive busses, to terminate the bus whenever a cord is not plugged into the jack. When a cord is plugged into the IN jack, the bus termination is performed at the IN jack of the next NAU.

  A modular cap covers the IN jack when a NAU is shipped. This cap should be removed only when the NAU is used in a daisy chain network.

- **OUT Connector:** The OUT jack connects the NAU to an NEU in a star configuration, or to the previous device in a daisy chain. The OUT jack provides contacts that short the transmit and receive busses together whenever a cord is not plugged into the jack. In daisy chains, when a cord is plugged into the OUT jack the bus short is provided by the next NAU or NIU.

- **PHONE Connector:** The PHONE jack is a convenience outlet for use when the STARLAN NETWORK is connected through building telephone wiring. In effect, it moves the jack from the wall to the back of the computer, thus enabling the phone and the computer to use a single wall outlet. It provides for FCC Part 68 registered terminal equipment (analog telephones, modems, etc.) that require a USOC RJ11 interface.

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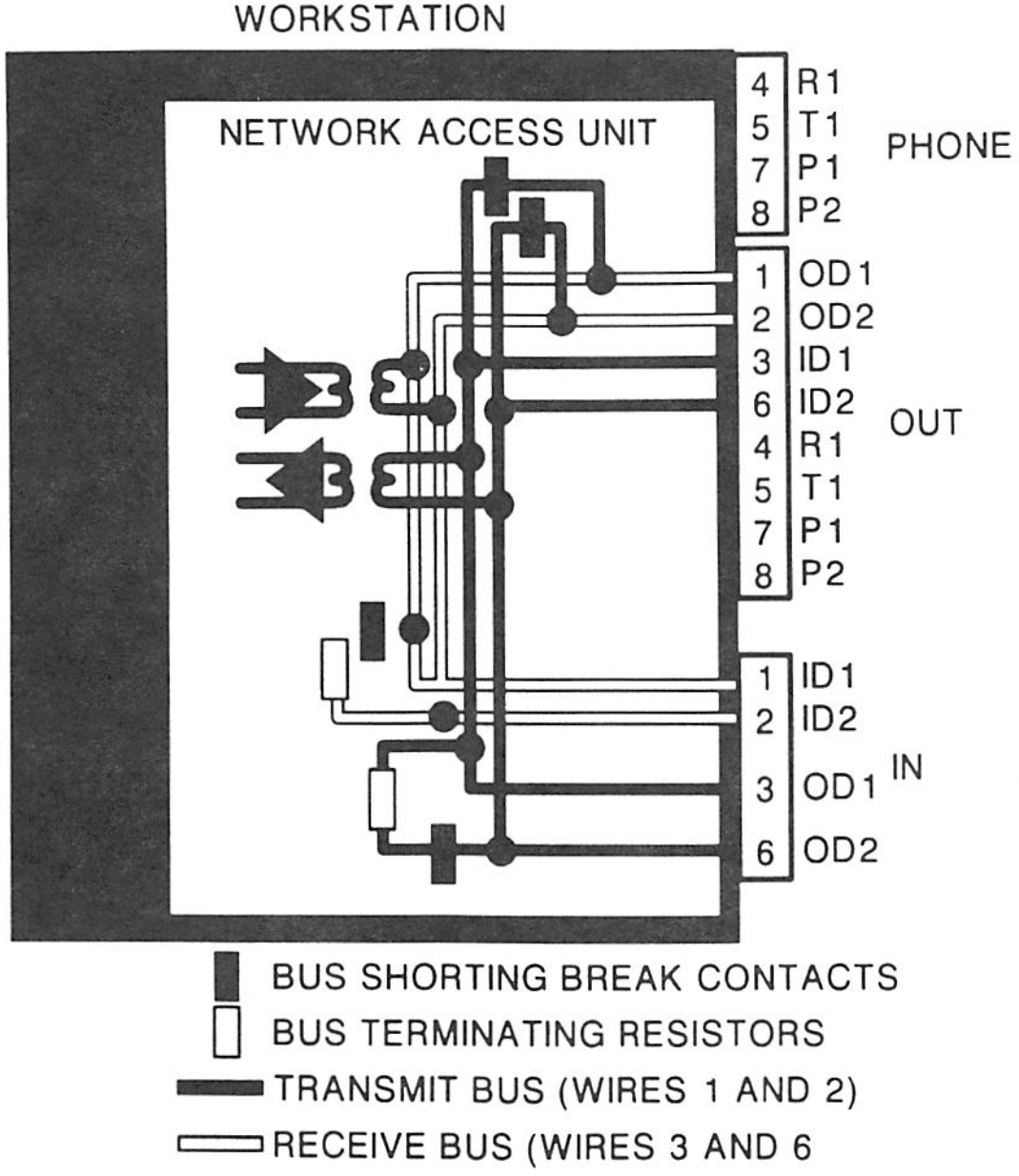
EXHIBIT B-3
NAU Functional Design



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The tip/ring pair of the PHONE jack is connected directly to the OUT jack and is not intercepted or controlled by the NAU. Also, pins 7 and 8 of the PHONE jack are connected to pins 7 and 8 of the OUT jack.

Power units located in the satellite closet provide power to operate the telephone via the station cord, the OUT jack and pins 7-8 of the PHONE jack.

The pin assignments for all three jacks are shown in Exhibit B-4.

The circuits that interconnect the IN and OUT jacks must be continuous at all times and are independent of the state of the power of the workstation. Since these circuits are part of the transmission medium, particularly in a daisy chain configuration, it is important to keep them as short as possible. This also minimizes the noise that can be coupled into the circuits and then onto the network.

b. Reliability Statistics

The NAU has a failure rate of one failure in seven years. Other reliability statistics are:

- Mean time to failure: more than 62,000 hours.
- First month failure rate: no greater than 5%.
- Short-term failure rate: no greater than 2.5% per month.
- Long-term failure rate: no greater than 1.2% per month.

c. The AT&T PC 6300 NAU

The PC 6300 NAU is used for all MS-DOS microcomputers, including the AT&T PC 6300 and PC 6300 PLUS, the IBM PC, XT, and AT, and compatibles.

The NAU has 8 KB of dual-ported on-board memory that is shared by both the 82586 and the host processor. Transmission begins when the host writes instructions to the NAU's memory. Then, the host asserts a channel attention through an I/O mapped command to inform the 82586 that instructions are waiting. The 82586 pulls the instructions and associated data (in transmission) from memory, and transmits. Collisions and other processing from this point on are handled by the 82586 and do not require host intervention.

The PC 6300 NAU has option straps that allow users to select the following values. This choice enables users to accommodate any conflicts between the NAU and other cards installed on the PC.

- **I/O Address:** Users may select between two address sets: 360-367 or 368-36F (hex).
- **RAM Address:** The user may select one of 16 pages (segments) in memory as a base address for the 8 KB of local on-board memory. The base address may be any segment starting at X0000, where X is a single hexadecimal digit 8 through E. The default segment is C0000.
- **Bus Interrupt Requests (IRQ):** The user may select one of four interrupt levels: 2, 3, 4 or 7.

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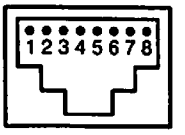
EXHIBIT B-4
NAU and NIU Pin Assignments



See Notes 1 & 2

8- Pin Modular Jack

Pin Numbers	Assignments		
	In Connector	Out Connector	Phone Connector
1	Incoming Data 1 (ID1)	Outgoing Data 2 (OD1)	No Connection
2	Incoming Data 2 (ID2)	Outgoing Data 2 (OD2)	No Connection
3	Outgoing Data 1 (OD1)	Incoming Data 1 (ID1)	No Connection
4	No Connection	Ring-Analog Telephone (R)	Ring-Analog Telephone (R)
5	No Connection	Tip-Analog Telephone (T)	Tip-Analog Telephone (T)
6	Outgoing Data 2 (OD2)	Incoming Data 2 (ID2)	No Connection
7	No Connection	Power for Telephone (P1)	Power for Telephone (P1)
8	No Connection	Power for Telephone (P2)	Power for Telephone (P2)

Note 1: Pins in the Modular Jack Are Numbered in Increasing Order from Left to Right with Tab Down and Facing Jack.

Note 2: Pin Assignments Are Identical for the NAU and NIU.

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d. The AT&T UNIX PC NAU

The UNIX PC NAU, unlike its PC 6300 counterpart, acts as a "bus master" with access to the PC's main memory. Thus, the UNIX PC NAU does not require on-board memory. (The NAU for the PC 6300 has access only to the 8KB of on-board memory.)

The UNIX PC communicates with the 82586 by leaving commands and data in main memory and then asserting the channel attention. The 82586 extracts the command and data from main memory and performs its assigned tasks.

There are no option straps on the UNIX PC NAU because the PC configures it automatically at startup, determining what type of card is plugged in and what slot it occupies. The PC makes I/O address assignments based on the slot number. For example, Exhibit B-5 shows the I/O mapping for Slot 1.

EXHIBIT B-5
UNIX PC NAU I/O Slot Assignments

UNIX PC Slot 1

Address	Write	Read
COXXXX C1XXXX C2XXXX C3XXXX	CA W WD CA W/ O WD Disable WD Reset	
C3XX00 02 04 06 08 0A 0C		Net Address { 08, 00, 6A, XX, XX, XX } Event Flag
CSXX18 1A 1C 1E		Board Type { 11, 21 } Complement Board Type { EF, DF }

Notes:
1) CA W WD = Channel Attention with Watch Dog Timer
2) Event Flag = 01 if WD Timed Out
= 00 Otherwise

The only board-level option is the interrupt. There is a soldered-in strap that must be cut and re-soldered to change the interrupt level in the unlikely event that a change is required. If a user needs to physically move to interrupt number five, documentation can be provided.

e. The AT&T 3B2 NAU

The current 3B2 NAU is a modification of the 3B2 3BNET access card. Like the other STARLAN NETWORK NAUs, it is based on an Intel 82586 microprocessor. Communications on the NAU is via DMA and interrupts.

The 3B2 has four card slots, with base memory locations of: 200000, 400000, 600000, and 800000. The host reads the base location plus one (e.g., 200001) to determine the type of board installed.

The 3B2 NAU has on-board memory used to download firmware from the 3B2, including both diagnostics and operating firmware. The on-board memory also contains the physical address of the NAU on the STARLAN NETWORK.

The 3B2 NAU has two lights on the faceplate, near the in, out and phone jacks. The lights indicate NAU function and are used for diagnostic purposes:

- **Amber:** This light goes ON whenever power is applied to the NAU. It flashes OFF whenever information is being sent from the NAU to the network. The nominal off time is 100 milliseconds.

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- **Green:** This indicator is normally OFF. It flashes ON whenever information addressed to the NAU is being received from the network. The nominal on time is 100 milliseconds.

2. Network Interface Unit (NIU)

The NIU is a standalone device that performs the same networking functions as an NAU for devices other than PCs or 3B2s. It provides STARLAN NETWORK connectivity for terminals, printers, modems, and other asynchronous devices. Once connected via an NIU, the device can function as though directly connected to a host computer, no matter what its physical location.

Each NIU provides two RS232 connectors, allowing two independent devices to be attached and communicate at 9.6 KB per second. Both attached devices have independent and equal access to the network. There is no limit to the number of NIUs that may be attached to a STARLAN NETWORK.

The NIU can either originate or accept virtual circuits to or from STARLAN NETWORK host computers and ISN hosts (using a SLIM-C module). Software in the host computer permits the devices connected via the NIU to operate as if they were connected directly to the host. For host computers running UNIX System V, the NIU originates a virtual circuit to the host computer, which starts a UNIX System log-in process to accept the virtual circuit.

Although the NIU performs all processing needed to transmit over the network, it does not offload the host computer's I/O processing. The host computer must still perform I/O processing as if the device were directly attached to the host.

a. NIU Connectors

The NIU provides the following connectors:

- **IN Connector:** There is one IN jack on the rear of the NIU. It is similar to the IN jack on an NAU and may be connected to the next device in a daisy chain network.
- **OUT Connector:** There is one OUT jack on the rear of the NIU. It is similar to the OUT jack on an NAU and may be connected to the previous device in a daisy chain, or a jack on the NEU in a star configuration.
- **PHONE Connector:** The PHONE jack on the rear of the NIU provides the same ability to connect analog telephones as the PHONE jack on an NAU.
- **Two RS232 Interfaces:** The RS232 interface connectors operate in asynchronous mode and are configured for DCE (Data Communication Equipment). The connector is a standard 25-pin female type. The pin assignments for the connector are shown in Exhibit B-6. The pin assignments for the NIU's in, out and phone jacks are the same as those for an NAU (see Exhibit B-4 above).

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EXHIBIT B-6
RS232C NIU Pin Connector

Pin No.	Name	Direction	Function
1	AA	-	Protective Ground
2	BA	To NAU	Transmitted Data
3	BB	From NAU	Received Data
4	CA	To NAU	Request to Send
5	CB	From NAU	Clear to Send
6	CC	From NAU	Data Set Ready
7	AB	-	Signal Ground
8	CF	From NAU	Received Line Signal Detector
9 - 19	-	-	No Connection
20	CD	To NAU	Data Terminal Ready
21 - 25	-	-	No Connection

Note: The Connector Is a Female Type.

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b. Dumb Terminals

A dumb terminal connected via an NIU can be used to perform the following functions:

- Log in to a STARLAN NETWORK host computer (UNIX PC or 3B2) running the UNIX System V operating system.
- Log in to an ISN node (mainframe, departmental processor, or other host).
- Log in to an SNA host node through a 3B2 computer on the STARLAN NETWORK equipped with the AT&T Emulator Plus communications package.

c. NIU Specifications

The NIU contains an 80188-family microprocessor chip, 128 KB of read-only memory (ROM), 32 KB of random-access memory (RAM) and some non-volatile memory. All options and user-specific identifications (e.g., logical device names) are stored in the non-volatile memory.

There are no option DIP switches. Data are collected until either 1024 characters or 200 milliseconds have passed. The data are then packetized and transmitted.

The NIU has green and yellow indicator lights that show when data are being transmitted or received. It requires 110 volts of power supplied from an external source (e.g., wall-mounted transformer).

On each of its two RS232 ports, the NIU provides:

- Baud rate: 110, 300, 1200, 2400, 4800, or 9600 bps.
- Number of data bits per character: 5, 6, 7, or 8.
- Number of stop bits: 1, 1.5, or 2.
- Parity: even, odd or none (ignore).
- Flow control: XON/XOFF, CTS/RTS, DSR/DTR, or NONE.
- Selectable alternate XON/XOFF characters.
- Select input buffer size.
- Select input buffer threshold.
- Select input buffer restart.
- Beep on input overflow.
- Select output buffer size.
- Selectable line feed pad character.

d. NIU Configuration Tables

The NIU contains three sets of configuration tables:

- **Session Table:** The session table resides in RAM and controls the current operation of the NIU. Configuration changes are valid only for the current session.
- **Permanent Table:** The permanent table resides in non-volatile memory and is retained when external power is turned off. When the NIU is first turned on, the values stored in the permanent table are used.

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- **Default Table:** The default table resides in ROM and is not changeable by the user. The default values are used when a port reconfiguration interrupt occurs. The user requests a port reconfiguration by pressing a switch for that port.

The NIU may take on a name that is stored in the non-volatile memory. Two logical names may be assigned per port. The NIU can run in a bi-directional mode that allows it to originate or accept calls. Alternatively, it may be set to originate only or to accept only. Accept-only is commonly used to connect printers to the network.

The reliability statistics for the NIU are identical to those of the NAU.

e. NIU Commands

The following commands may be used, in command mode:

- **Call:** Used to initiate a call, this command allows the user to call a particular device to establish a virtual circuit.
- **Resume:** This command is used to resume a previously-established virtual circuit.
- **Display:** This command displays the NIU options and network addresses currently in use.

3. Network Extension Unit (NEU)

The Network Extension Unit acts as the center of a star configuration. It is a standalone device that provides 11 IN jacks and one OUT jack for making connections with NAUs, NIUs, and other NEUs.

In addition to providing the physical connections for a star network, the NEU extends the maximum length of the network: from the 400-foot maximum in a daisy chain to an 800-foot maximum distance between the NEU and any device. The NEU does this by performing the following functions:

- Amplifies received signals to the standard transmission level before sending them back onto the network.
- Provides collision detection for the entire network.

The NEU monitors activities in all 11 IN ports. If it detects more than one receive carrier signal, the NEU blocks all transmissions and sends a "collision presence" signal onto the network. The NEU continues to send the collision presence signal until all NAUs and NIUs on the network stop transmitting.

a. NEU Connectors

The NEU provides the following interfaces:

- **IN Connectors:** The NEU has 11 IN ports that connect to NAUs or NIUs. These ports have 8-pin modular jacks that terminate DW8A-type cords.

  In a star configuration that contains more than one NEU, the master NEU may use one or more IN jacks to connect to secondary NEUs.

- **OUT Connector:** The NEU has one OUT port used to connect with a

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master NEU. Like the IN ports, it has an 8-pin modular jack and terminates a DW8A-type cord. The OUT port also provides contacts that short the transmit and receive busses together whenever a cord is not plugged into the port. If a cord is plugged in, the busses are shorted by the device connected through the OUT jack.

A modular cap covers the OUT jack when an NEU is shipped. Remove the cap only if the NEU is being used as a branch hub connected to a master NEU.

- **Power Interface:** A connector on the bottom of the NEU connects to a wall-mounted transformer that supplies low-voltage AC power. The connector has a locking feature so the power cord cannot be accidentally removed. There is no on/off switch on the NEU; power is continuous whenever the power interface is plugged into an outlet.

The pin connector assignments for the NEU are shown in Exhibit B-7.

b. Visual Indicators

The NEU has two lights on front of the unit. Both lights are on whenever power is applied to the NEU. They flash to indicate incoming or outgoing traffic:

- **Amber:** The amber light flashes OFF for 100 milliseconds whenever there is inbound traffic from the network on any IN port.

- **Green:** The green light flashes OFF whenever there is outbound traffic on the common transmit bus destined for the IN jacks.

c. Reliability Statistics

The NEU has a failure rate of one failure in five years in an average network configuration (i.e., two NEUs). Other reliability statistics are:

- Mean time to failure: more than 87,000 hours.

- First month failure rate: no greater than 3.4%.

- First year failure rate: no greater than 2.5% per month.

- Long-term failure rate: no greater than 0.83% per month.

B. Transmission Media

The STARLAN NETWORK uses commercial-type telephone wire as the primary transmission medium. This wire consists of 24-gauge solid copper twisted pair wires. The network uses two pairs: one for the transmit bus and the other for the receive bus. Devices connect to the network wiring with eight-pin modular jacks.

The basic wiring components are as follows:

- Modular (DW8) cords and connectors.
  - -- Cords available in 10, 25, 50, 75, 100, 150 and 200 foot lengths.
  - -- One 10-foot cord is supplied with each NAU.

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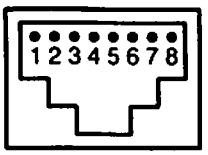
EXHIBIT B-7
NEU Pin Assignments



See Note 1

8- Pin Modular Jack

Pin Numbers	Assignments	
	In Connector	Out Connector
1	Incoming Data 1 (ID1)	Outgoing Data 2 (OD1)
2	Incoming Data 2 (ID2)	Outgoing Data 2 (OD2)
3	Outgoing Data 1 (OD1)	Incoming Data 1 (ID1)
4	No Connection	No Connection
5	No Connection	No Connection
6	Outgoing Data 2 (OD2)	Incoming Data 2 (ID2)
7	No Connection	No Connection
8	No Connection	No Connection

Note 1: Pins in the Modular Jack Are Numbered in Increasing Order from Left to Right with Tab Down and Facing Jack

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-- Modular adapters may be used for connecting two modular cords to re-establish broken connections in a daisy chain.

- Four-pair twisted-pair, 24-gauge unshielded cable.

Daisy chain topologies cannot use building wiring, but otherwise use the same 24-gauge wire described below.

1. Wire Specifications

In addition to AT&T PDS wiring, any wire is suitable if it corresponds to the Insulated Cable Engineers Association Standard for Telecommunications Wire and Cable for Wiring Premises. AT&T-IS D-type Inside Wire is among those qualified.

- Wire size and type: The network uses D8W-A and 24 AWG solid copper twisted pair cords. Each wire is individually insulated but the cords are non-shielded. The twisted wire pairs in 3, 4, 6, 12, 16, 21, 25, 40, 50, 75, 100, 125, 150, and 300 pair cords may be used.

- Continuity and shorts: To assure a reliable transmission medium, the wire must be electrically continuous and free from shorts and stubs.

- Conductor resistance (maximum): 28.6 ohms per 1000 feet at 20 degrees Centigrade.

- Average mutual capacitance (maximum): 36 nF per 1000 feet at 20 degrees Centigrade.

- Coaxial capacitance (maximum): 150 nF per 1000 feet at 1000 Hz and 23 degrees Centigrade.

- Pair-to-pair capacitance (unbalanced maximum): 70 pF per 100 feet at 1000 Hz.

- Insulation resistance, each conductor (minimum): 300 Megohms per 1000 feet at 23 degrees Centigrade.

- Characteristic impedance: 92.5 ohms at 1.0 megahertz.

- Media loss (maximum): 8.5 dB per 1000 feet at 1.0 megahertz.

- Metallic coupling loss (minimum): 65 dB at 1.0 megahertz.

- Longitudinal coupling loss (minimum): 34 dB at 1.0 megahertz.

- Crosstalk loss: The loss presented to signals appearing on one wire pair from coupling to other wire pairs in a cable:

  -- Pair to pair near end crosstalk loss (minimum): 50 dB at 1.0 megahertz.

  -- Power sum near end crosstalk loss (minimum): 40 dB at 1.0 megahertz.

  -- Pair to pair equal level far end crosstalk loss (minimum): 45 dB at 1.0 megahertz.

  -- Power sum equal level far end crosstalk loss (minimum): 40 dB at 1.0 megahertz.

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C. Networking Protocols and Standards

The STARLAN NETWORK has been designed in accordance with the IEEE 802.3 draft proposal as of June 1985, Draft A. This standard is similar to Ethernet, except that it supports 1 Mbps over unshielded twisted pair as opposed to Ethernet's 10 Mbps over coaxial cable.

For a full description of CSMA/CD, and an explanation of the ISO Reference Model for networking, please see Appendix A.

1. 802.3 CSMA/CD Transmissions

Key parameters of the 802.3 standard include the following:

- Slot time: 512 bit times.
- Inter-frame gap: 96 microseconds.
- Attempt limit: 16 (the number of times the link-level protocol will attempt to send a message).
- Maximum frame size: 1518 octets (bytes).
- Minimum frame size: 64 octets (bytes).
- Address size: 48 bits.

a. Media Access Control

CSMA/CD is the 802.3 Media Access Control (MAC) sublayer. MAC provides control for accessing the communications bus, and it also provides for error detection. The components of the MAC frame are:

- Preamble: 0x55 repeated seven times.
- Start of frame delimiter: 0xd6.
- Destination address: 6 octets.
- Source address: 6 octets.
- Length: 2 octets.
- Logical link control data: variable.
- Pad: variable.
- Frame check sequence: 4 octets.
- Frames with CRC errors are discarded.

b. Logical Link Control

The 802.3 Logical Link Control (LLC) sublayer identifies the protocol being used at higher levels. The STARLAN NETWORK does not implement the full LLC protocol. Instead, it provides the Unnumbered Information (UI) header associated with LLC Type 1 operation. This allows for mixing different protocols over the same network in the future. The LLC UI frame contains the following fields:

- Destination service access point identifier: 1 octet.
- Source service point identifier: 1 octet.
- Control: 1 octet.
- Information: variable.

2. Network Addresses

Network addresses are unique across both the STARLAN NETWORK and the 10 Mbps Ethernet standard. This allows STARLAN NETWORKs to link with

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other networks without requiring new addresses for network devices.

Addresses include all possible 48-bit combinations with the first three bytes frozen at: 08006A (hex). The net address is transmitted in time as follows:

- The first bit (i.e., broadcast bit) of the most significant byte is transmitted first. This bit is not part of the normal address field and normally it is set to zero to show point-to-point communication. If set to one, this bit indicates multicasting or broadcasting.
- Transmissions send the least significant bit of each byte first.

3. Network Signals

STARLAN NETWORK transmissions are organized into data packets with gaps of at least 96 microseconds between them. The network uses Manchester data encoding, which provides the following values:

- "One" has a 0.5 microsecond negative voltage pulse followed by a 0.5 microsecond positive pulse.
- "Zero" has a 0.5 microsecond negative pulse.

The network idle state is zero volts. Received signal levels are 1.5 volts peak to peak minimum. Signal quality (collision detection) is determined by a time base and amplitude analysis.

The STARLAN NETWORK circuits cannot be damaged by accidentally coming into contact with a PBX power supply (non-current-limited 48 volt direct current power supply). The STARLAN NETWORK circuits recover automatically.

4. Transmission Reliability

The STARLAN NETWORK falls within the following reliability parameters:

- Attenuation (drop of signal over maximum distance): The worst case attenuation was taken into consideration when determining the maximum distance (800 feet) between an NEU and NAU.
- Crosstalk (interference from nearby equipment): The STARLAN NETWORK is designed to handle 600 millivolts of crosstalk (peak to peak). The worst-case expected amount of crosstalk between STARLAN NETWORK components is 150 millivolts. Near-end crosstalk gets worse as transmission frequencies get higher.
- Noise: The STARLAN NETWORK has a maximum noise level of 500 millivolts.
- Jitter: Jitter can come from several sources including the transmitting driver, the receiver, and cable interference. The STARLAN NETWORK can handle 90 nanoseconds peak jitter.
- Radio Frequency Interference (RFI): The worst case of the network failing because of RFI was with a field strength of 8 volts per meter.

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The following are the maximum expected error rates for a network with a typical traffic mix:

- Dropped connections: 1 per 1000 connection hours.
- Unsuccessful print requests: 1 per 1000 requests.
- Unsuccessful read or write requests: 1 per 10**5 requests.
- Terminal-to-host bit errors: 1 per 10**8 bits.
- Undetected collisions: 1 per 1000 collisions.
- Excessive collisions errors: 1 per 1000 collisions.

D. Network Diagnostic Software

Board diagnostic software comes with each STARLAN NETWORK hardware component (NAU, NIU and NEU). Network diagnostics come with the STARLAN NETWORK software. The diagnostics check component functions and test network response. The network can remain in operation while the diagnostic software is used.

The board diagnostic services include:

- Local traffic counts, including error counts and retry counts, accumulated so the network manager can display them.
- Self-test procedures, including loopback and carrier sense tests.
- Transmission verification, including receipt of messages, device identification and the technical reliability of connected workstations.
- NAU configuration checks and whether the NAU conflicts with boards in other expansion slots on the same device.

E. Network Software Architecture

There are two STARLAN NETWORK software architectures -- one for MS-DOS and the other for the UNIX Operating System.

1. MS-DOS Networking Software

The PC 6300 Network Program contains the necessary software for both client and server operation on PCs running MS-DOS Version 3.1 or later.

Concurrent client/server operation requires multi-tasking and a multi-threaded file system -- neither of which are provided by MS-DOS. Therefore, the STARLAN NETWORK software uses special software (MINDSPRO™ and CIOSYS) to allow concurrent multiple file access.

Other than the MINDSPRO and CIOSYS software, the STARLAN NETWORK uses the MS-DOS system and the Microsoft Network Redirector program as the basis of its MS-DOS networking software.

a. Client Software

The client software includes the following modules:

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- **Menu-Driven User Interface:** The PC user runs this software to obtain access to network resources. It provides simple menus to establish connections with file servers on the network and perform print spooling, file access, and other functions. The user may terminate currently-running applications and call up the Menu-Driven User Interface at any time to establish or change connections.

- **Command Line Interface:** This software performs the same functions as the Menu-Driven User Interface, but is designed for experienced users who prefer to enter commands rather than select functions from a menu. It also allows the user or network administrator to remotely administer server functions.

b. Server Software

The File/Print Server Software enables a PC to act as a file and printer server for MS-DOS workstations. It executes the "core file and print sharing protocol" and translates network requests into actual disk or printer I/O operations. Administrative capabilities allow users to control buffer sizes, initialization options, printer spooling, and the number of open files and sessions. The user can assign a logical name to each MS-DOS device on the network.

c. Protocol Layers

Exhibit B-8 shows how the STARLAN NETWORK software for MS-DOS devices fits into the ISO Reference Model for networking. For an explanation of the ISO model, please refer to Appendix A.

The NETBIOS emulation is provided at the session level (Layer 5) by a program that remains resident in the PC. Under the transport level (Layer 4), there are two protocols:

- **Universal Receiver Protocol (URP):** This protocol is a guaranteed-delivery protocol that ensures connectivity with the UNIX System and with ISN. It provides a virtual circuit between devices on the network.

- **Datagram Service:** This protocol does not guarantee delivery to the receiving device. It is used to send messages between users and to broadcast messages throughout the network.

d. MS-DOS Application Programming Interfaces

There are three program interfaces available that make it easy to develop MS-DOS software that takes advantage of STARLAN NETWORK capabilities. These interfaces support most software written for the MS-NET and IBM PC Network products. They are:

- **DOS Interrupt (INT 21):** This is the standard interface provided by MS-DOS Version 3.1 and the MS-NET Redirector. Software written using this interface should be compatible with any equipment using MS-DOS, and should also be compatible with future DOS releases.

- **Session-Level Interrupt (INT 2A):** This interface offers STARLAN NETWORK commands, including those necessary to establish a connection between devices. It is an intermediary level between DOS and the NETBIOS

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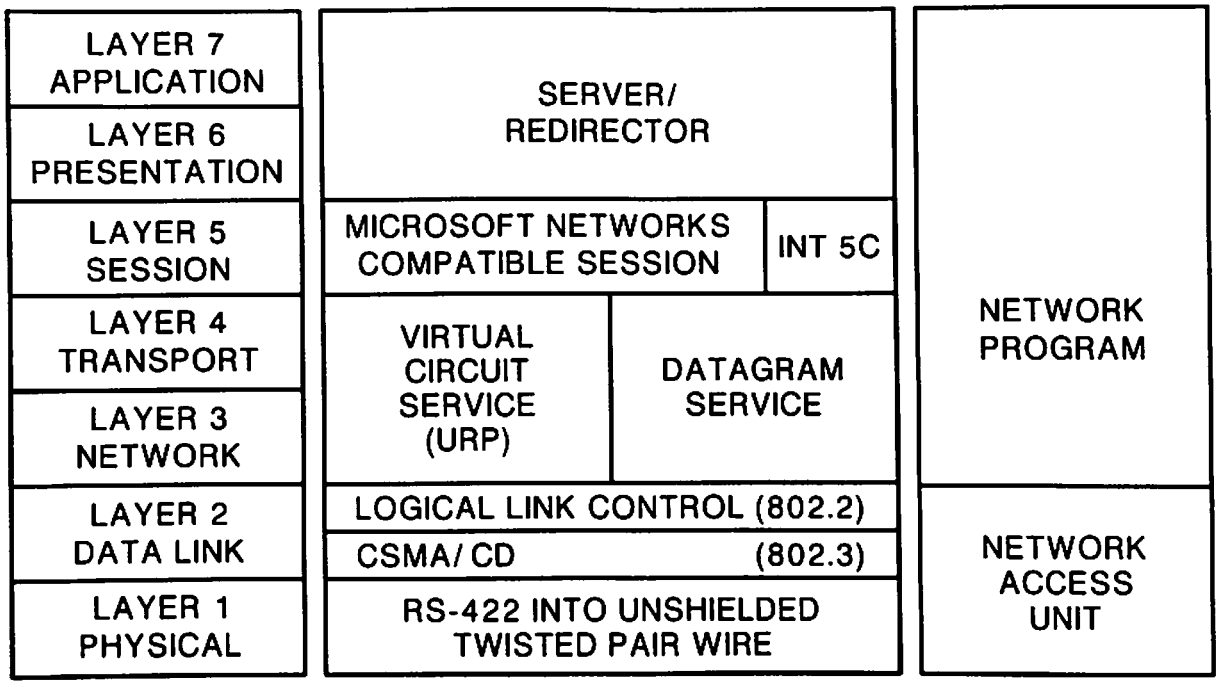
EXHIBIT B-8
MS-DOS Architecture and the ISO Model



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Emulator. Since it interfaces to software and not directly to hardware (as the NETBIOS Emulator does), the session-level interrupt is more flexible and can accommodate future changes that the NETBIOS Emulator could not support.

- NETBIOS Emulator (INT 5C): This level emulates, through software, IBM's hardware-resident NETBIOS. This allows compatibility with IBM software. It is recommended that developers use the session-level interface (INT 2A) instead of this one to assure future compatibilities.

These interrupt levels are described in more detail below. Applications can go through the INT 2A interface and bypass DOS entirely. An example of such an application might be a terminal emulation package.

(1) DOS Interrupt (INT 21)

This level is best suited for applications that do not require knowledge of STARLAN NETWORK communication protocol specifics. This level consists of MS-DOS Version 3.1 system calls and provides the programmer with the following capabilities:

- Standard character device I/O.
- Memory management.
- Process management.
- Directory management.
- File sharing.
- File and record locking (this is essential on a STARLAN NETWORK or in any environment that allows file sharing, but is not necessary on a standalone workstation that is operating independently of other users).
- Printer sharing and spooler functions.
- Miscellaneous system functions.

For more information about this interface, refer to the MS-DOS 3.1 Programmer Reference Manual.

(2) Session-Level and NETBIOS Emulator Interrupt Levels

These two interfaces are identical at present. However, future enhancements and changes may be made at the session level. The NETBIOS interface, which emulates IBM hardware, is less flexible and is not likely to support future changes. Therefore, software developed at the higher, session level will have fewer compatibility problems in the future than software written to use the NETBIOS Emulator directly.

Both interfaces provide the following commands and capabilities:

- General commands used to enable the network, get status, and control other commands:
  - -- Reset: Resets the local adapter status and clears the name and session tables.
  - -- Cancel: Cancels a previously-issued command.

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-- Status: Reports status information for a local or remote adapter.

- Name support commands allow a PC to be known by a unique name on the network:
  - -- Add name: Adds a unique 16-character name to the network name table.
  - -- Add group name:
  - -- Delete name: Deletes a name from the network name table.
- Session support commands establish and control data flow on the network:
  - -- Call: Open a session with the named PC on the network.
  - -- Listen: Wait for a session to be established with another PC on the network.
  - -- Hang up: Close a session with the named PC.
  - -- Send: Transmit one buffer of data.
  - -- Chain send: Transmit two buffers of data.
  - -- Receive: Receive data from a specified session.
  - -- Receive any: Receive data from any session established.
  - -- Session status: Receive status of all active sessions.
- Datagram support commands establish and control messages on the network:
  - -- Send datagram: Send to unique or group name.
  - -- Send broadcast datagram: Send to all nodes with outstanding "receive broadcast datagram" commands.
  - -- Receive datagram: Receive datagram from anyone.
  - -- Receive broadcast datagram: Receive datagram from anyone who issues "send broadcast datagram."

e. Driver Architecture

The STARLAN NETWORK MS-DOS driver implements the NETBIOS Emulator (interrupt 5C) through the interrupt handler named SESSION.EXE. This is a "terminate and stay resident" program that translates commands for the XPORT.EXE program. The XPORT.EXE program, in turn, supports the full Microsoft Transport Layer Interface (5B).

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2. UNIX System Network Software

The STARLAN NETWORK software for UNIX System devices consists of two products:

- **Network software:** This allows the device to communicate with other UNIX System machines on the network to transfer files and share printers. It also supports remote login sessions from UNIX System or MS-DOS workstations running terminal emulation programs.
- **Server software:** This allows the device to act as a file server for MS-DOS client workstations.

The network software is required only if the device will communicate with other UNIX System devices over the STARLAN NETWORK. The DOS Server Program is required if the device will also act as a server for MS-DOS workstations.

The network software includes modified versions of certain existing UNIX System programs. These include uucp, mail and rmail.

The software architecture and functions are similar for both the UNIX PC and the 3B2; however, the 3B2 software has an additional Administration/Maintenance module.

Exhibit B-9 shows how the STARLAN NETWORK software for the UNIX System fits into the ISO standard protocols.

a. Transport Level Interface Library

Users can write applications to access the STARLAN NETWORK through the Transport Level Interface (TLI) Library, which in turn invokes the other STARLAN NETWORK software and communicates with the UNIX System kernel and the NAU.

The Transport Level Interface (TLI) makes it easy to write programs that take advantage of STARLAN NETWORK communication capabilities. Applications may be written independently of the underlying protocol. Programs written under TLI are entirely compatible with UNIX System V, Release 3.0 and later.

Besides providing a connection with a specific destination, TLI provides a method of "connectionless" communication. It supports the following functions:

- Initialize and deinitialize the network.
- Establish connections between devices.
- Transfer data between devices.
- De-establish connections.

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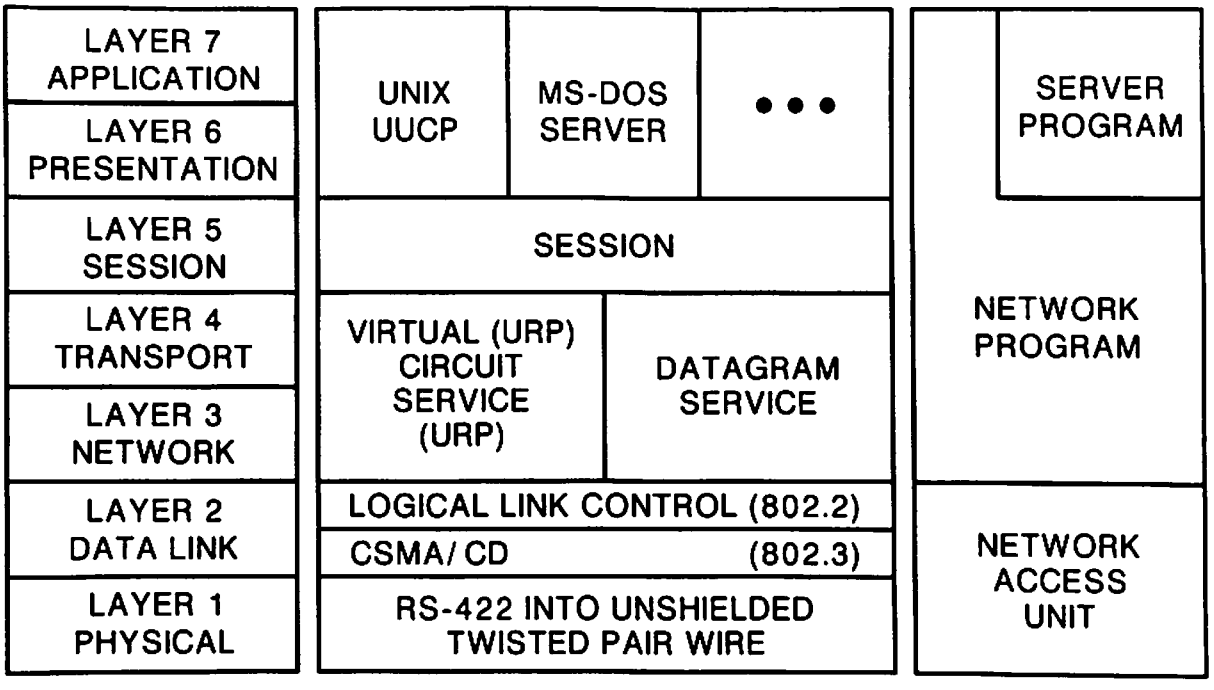
EXHIBIT B-9
UNIX System Architecture and the ISO Model



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b. The Listener Process

The Listener Process resides on each UNIX System device on the network. It listens for a connection request from a network user or application. The request may use either of two names to address the listener: either the "nodename" or the "pnodename." Depending on which name is used, the Listener provides the following services to the workstation that made the request:

- **Remote login:** Allows users or applications on other workstations to log onto the Listener workstation. This allows users to access resources attached to the Listener device, including disk drives and printers. When it receives a login request, the Listener establishes a virtual circuitry between itself and the requester and begins the standard "login" and "password" process.
- **Other Services:** Other services include:
  - -- uucp: Perform file transfers.
  - -- Remote print: Handled through "uucp" and "uux."
  - -- Electronic mail: Transparent delivery of mail messages.
  - -- MS-DOS file serving: If the appropriate server software is installed, the Listener device may act as a file server for MS-DOS PCs.

c. The STARLAN NETWORK Media Driver (SMD)

The media driver sends and receives packets of information between NAUs. The driver contains the following modules:

- **Call Control Module:** This module creates the connection between sender and recipient. It translates the logical names of network devices into physical network addresses and sends messages to the appropriate address(es). When a response is received, it sets up a virtual circuit between the devices. Once it has set up the virtual circuit, the call control module's work is done and it does not influence the rest of the processing.
- **Universal Receiver Protocol (URP):** This module takes over communication activities once the call control module finishes establishing the connection. It transfers data using the URP protocol standard for the AT&T ISN system. It supports two service modes:
  - -- Block mode: Guarantees end-to-end delivery, provides flow control with optional error detection and correction, and supports approximately 1500 bytes per data packet.
  - -- Character mode: Sends information onto the network with no guarantee of delivery and supports 1 byte per packet.
- **Datagram/Hardware Module:** This module supports demultiplexing of incoming data packets and interfaces

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directly to the NAU and other network hardware.

- **Administration/Maintenance Module** (3B2 only): Maintenance is performed by a user-level daemon process, through a kernel module (SRM) to the administration function of the Media Driver. The functions include:

  -- Initializing operational firmware.

  -- Initializing and removing nodes from the network.

  -- Gathering local node statistics for administrative reporting purposes.

d. Network/Transport Software

This module attaches the appropriate network headers on user data and sends data packets to the Media Driver. It performs the following functions:

- Attaches and advertises the local node to the transmission medium.
- Assigns unique logical channel numbers to upstream data queues.
- Establishes virtual circuits between devices.
- Demultiplexes incoming messages using their logical channel numbers.

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APPENDIX C: STARLAN NETWORK INTERFACE TO ISN

This appendix discusses the additional capabilities available to STARLAN NETWORK users who are already ISN customers, or who have varied, large-scale networking needs that would justify ISN purchase. It is not expected that users will purchase ISN merely to extend STARLAN NETWORK capabilities. However, users who need ISN will find that it can enhance the STARLAN NETWORK's ability to function as an integrated part of the organization's total data communication system.

A. The Information Systems Network

The AT&T Information Systems Network (ISN) is a local and wide-area network introduced in June, 1984. It is primarily designed for continuous, high-volume communication traffic and it is intended to unify the computing needs of medium and large-sized businesses. It is particularly well-suited for building-wide and campus-wide connectivity. ISN provides communication support for:

- Terminal-to-host interactive communication.
- Host-to-host file transfer.
- Inter/intra premises networking between locations within and outside the building.

ISN provides data transmission through a variety of connections, including:

- Twisted-pair PDS wiring.
- Fiber-optics cables.
- Modem connection to remote sites.

The ISN uses a centralized packet controller for processing and switching throughout the entire network. Smaller concentrators are located at various sites to perform local switching.

B. Connectivity Between the STARLAN NETWORK and ISN

STARLAN NETWORKs can become part of the customer's larger ISN system. Generally, the way to accomplish this is to attach an ISN Concentrator (or Packet Controller) as a device on the STARLAN NETWORK. STARLAN Interface Modules, installed on the concentrator or controller, have the necessary "in" and "out" jacks; run a wire from the "out" jack of the module to the "in" jack of an NEU. Maximum distance between the interface modules in the ISN Packet Controller or Concentrator and the hub is 800 feet. Once linked to the ISN, STARLAN NETWORK workstations can:

- Communicate with devices on other STARLAN NETWORKs in other locations.
- Communicate with ISN devices.
- Use ISN resources for:
  - -- SNA support.
  - -- Synchronous/asynchronous traffic.
  - -- Long-distance remote connectivity.

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-- Connectivity to System 75 or System 85 voice networks.

-- Other ISN services.

Each STARLAN NETWORK which is connected to ISN must still, internally, abide by the distance and number-of-device limitations described earlier.

C. STARLAN NETWORK Interface Modules for ISN

Two modules are available for ISN-STARLAN connectivity. They are collectively known as STARLAN Interface Modules (SLIMs). Any one ISN Concentrator may contain one and only one of each module.

- **SLIM-B Bridge Module:** Connects two or more separate STARLAN NETWORKs so they appear to be a single large network. This provides a way to connect more devices or exceed the distance limitations of the STARLAN NETWORK. In fact, using fiber-optic cables, it is possible to bridge STARLAN NETWORKs over long distances. One SLIM-B module must be installed at each STARLAN NETWORK site to be bridged.

- **SLIM-C Connection Module:** Connects a STARLAN NETWORK to the ISN network so STARLAN NETWORK workstations can communicate with other nodes on the ISN. If more than one STARLAN NETWORK is bridged using a SLIM-B module, they can all share a single SLIM-C located on any network.

1. SLIM-B Bridge Module

The SLIM-B connects separate STARLAN NETWORKs through a "permanent virtual circuit." The bridge is entirely transparent; to the user it appears as though the separate LANs are in fact a single network.

Up to nine STARLAN NETWORKs may be bridged into a single virtual network. Such a group of bridged networks is known as an extended network. The entire ISN system can support up to three separate extended networks. STARLAN NETWORKs do not communicate across extended networks (except as separate ISN nodes communicating through the SLIM-C module).

Specifications of the SLIM-B:

- Transmits 1000 packets of data per second.

- Throughput is 1 megabit per second.

- Corrupted packets are flagged and discarded to ensure accuracy of transmission.

- The SLIM-B module learns addresses of attached stations.

- Remote end-points are addressed in the same manner as local end-points.

Since the SLIM-B makes different STARLAN NETWORKs appear to be one network, no ISN call setup is required. The SLIM-B adaptively learns the locations of other devices on ISN according to their physical addresses, and routes information accordingly.

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2. SLIM-C Connection Module

The SLIM-C allows STARLAN NETWORK workstations to access ISN resources, including transport services, trunking, file sharing and modem pools. STARLAN NETWORKs can also take advantage of ISN's common administration and reporting.

Asynchronous devices connected via the NIU and other STARLAN NETWORK workstations communicate with other ISN endpoints via switched virtual circuits. Connections are supported with:

- Asynchronous terminals.
- Asynchronous hosts.
- Asynchronous devices such as modem pools.
- Workstations on ISN/STARLAN NETWORKs with emulation packages.
- Hosts on STARLAN NETWORKs supporting remote terminals.
- UNIX System workstations on ISN/STARLAN NETWORKs.
- Multiplexed hosts on ISN.
- SNA communication services.
- Synchronous/asynchronous protocol conversion services.
- Voice networks such as System 75 or System 85.

The SLIM-C integrates STARLAN NETWORK and ISN termination endpoints. Each workstation gets an ISN endpoint profile as follows. The profile includes:

- User type.
- Physical address.
- Numeric address.
- Mnemonic address.

The SLIM-C module has the same throughput as a SLIM-B and supports the same number of simultaneous connections as the SLIM-B.

The SLIM-C sets up a call to a STARLAN NETWORK device by broadcasting a message addressed to that device. When the called device responds with its physical address, the SLIM-C sets up a virtual circuit. The two endpoints use the URP standard protocol for communication.

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APPENDIX D: GLOSSARY OF USEFUL TERMS

To assist your understanding of the AT&T STARLAN NETWORK's capabilities and configurations, here are concise explanations of AT&T STARLAN NETWORK terms.

This section provides concise explanations of technical terms for readers unfamiliar with communications wiring and local area networks.

Adapter

A device that enables different sizes or types of plugs to connect to one another, and that provides for the rearrangement of wires.

Analog Phone

A phone that uses a continuously varying electrical signal to transmit and receive voice. It generally requires a single pair of wires. An example is the standard home phone.

Appearance

The electrical contacts from a phone, workstation, or other communications device. For example, wire leads coming from a device, or the contacts on a cross connect block or modular jack to which a device is wired.

AT&T Network Access Unit (NAU)

A plug-in expansion card that enables AT&T STARLAN NETWORK workstations and servers to exchange and access data through the network.

AT&T Network Extension Unit (NEU)

A wall-mounted device that increases the number of workstations and servers connected in an AT&T STARLAN NETWORK, and extends the distances between them. It contains 12 modular jacks: 11 IN jacks for connections from devices, and 1 OUT jack for connecting the NEU to a Master NEU.

Basic Input-Output System (BIOS)

The component of the MS-DOS operating system in each workstation that performs the actual communication with input and output devices such as printers, disks, and keyboards.

Carrier Sense Multiple Access With Collision Detection (CSMA/CD)

A technique that enables numerous independent network devices to share a common broadcast communication channel without requiring a central transmission allocation authority.

Central File

A file stored on a server and meant to be shared by network users.

Client

Any user or user program that requests a service from another workstation.

Closet Star

An AT&T STARLAN NETWORK configuration in which workstations and servers are electrically connected through a wiring closet. The workstations and servers are plugged into modular wall

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outlets, where they access unused pairs in the phone wiring. The unused pairs, in turn, are connected to a Network Extension Unit in the wiring closet.

Configuration

The layout of phones, workstations, and other communications devices in a communications system.

Connecting Block

See Modular Jack.

Cross Connect

A panel (also called a "field" or "wiring block") on which the leads of station cable are mounted so that an AT&T Systems Technician, other wiring craftsperson, or the system administrator can make electrical connections between the communications devices wired to the cables.

Cyclic Redundancy Check (CRC)

A numeric value derived from the bits in a message that is used to check that message for bit errors during transmission.

Daisy Chain

An AT&T STARLAN NETWORK configuration in which workstations and servers are linked together with modular cords.

Digital Phone

A phone that uses a discontinuous signal to provide data communications and other features, in addition to using an analog signal for voice communications. It generally requires from two to four pairs of wires: one pair for the analog voice signal, and the remaining pairs for the digital signals.

Disk Operating System (DOS)

Used to refer to Microsoft's MS-DOS operating system.

DOS Interrupt

A program interface for application software on MS-DOS workstations, invoked via the INT 21 instruction.

Hub

In a star configuration, the AT&T Network Extension Unit (NEU) or group of NEUs to which the workstations and servers are wired.

Listener

A process for UNIX System workstations that enables user processes to request and invoke the services of a remote network server workstation.

Master Network Extension Unit

A Network Extension Unit (NEU) to which other NEUs in the same hub are connected. The OUT jack of a secondary (or "branch") NEU is linked by a modular cord to an IN jack of the Master NEU.

Modular Cord

A cord containing four pair of wires, with a modular plug on one or both ends.

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Modular Jack

Also called "connecting block" and "modular wall outlet." A receptacle used with a modular plug to make electrical contact between circuits and communications devices such as phones and workstations.

Modular Wall Outlet

See Modular Jack.

NETBIOS Emulator Interrupt

A program interface for application software on MS-DOS workstations. This interface emulates the NETBIOS interface provided with IBM's local area networks. Invoked via the INT 5C instruction.

Network Access Unit (NAU)

A circuit board that, when inserted into an expansion slot of a personal computer, allows the personal computer to transmit and receive information over the network.

Network Address

A number that designates the location of a device on the network. When network software is connecting to a remote device on the network, the remote device is identified by means of its Network Address.

Network Extension Unit (NEU)

A wall mountable unit that connects up to 11 "legs" of a star configuration. Each "leg" may support one to ten devices.

Network Hub

See Hub.

1A-key system

The AT&T wiring system for the 6-button phones called 1A-key sets.

110-type wiring environment

The AT&T wiring system in which phones, workstations, and other communications devices can be easily added and rearranged with modular wiring components and patch cords.

Patch Cord

A short length of wire with connectors on each end used at cross connects. It completes a circuit by connecting incoming wire pairs on one cross connect to outgoing wire pairs on another.

Plenum Cord

Phone cord with fire-retardant insulation, generally used in suspended ceilings and other places where air circulates back to the building's air-conditioning system.

Printer Sharing

An AT&T STARLAN NETWORK server's ability to allow many workstations to share a single printer.

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Room Star

An AT&T STARLAN NETWORK configuration in which workstations and servers in a single room are connected to a Network Extension Unit.

Secondary Network Extension Unit (NEU)

In an AT&T STARLAN NETWORK hub, a Network Extension Unit whose OUT jack is connected by a modular cord to the IN jack of the Master NEU.

Session Control Block

A 64-byte data structure used to submit Session Level Interrupt and NETBIOS Emulator Interrupt commands for transmission over the network. The Session Control Block consists of a number of predefined fields that are used to store particular data for each command.

Session Level Interrupt

A program interface for application software on MS-DOS workstations. Invoked via the INT 2A instruction.

Server

An AT&T STARLAN NETWORK computer with a hard disk, running special software that enables the server to provide file storage, central files, and printer sharing for network workstations.

66-Type Wiring Environment

The older AT&T wiring system, now being replaced by the 110-type, in which a special tool must be used to attach to the cross connect the twisted pairs from phones, workstations, and other communications devices.

Station Cable

The cable connecting phones, workstations, and other communications devices from a user location -- the "station" -- to the wiring closet.

Transport Endpoint

A local file descriptor on a UNIX System that identifies a communications path between a transport user and a transport provider.

Transport Level Interface

A program interface to the transport level services for UNIX System application software.

Twisted Pair

A pair of insulated copper wires twisted around each other. The type of wire used in the AT&T wiring environment.

Unused pair

A pair of unused wires in a station cable.

Wiring closet

A room, closet, or cabinet where station cable is terminated on cross connect blocks and where the building communications system can be administered.

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Wiring Environment

Any building communications wiring system. See also 1A-key system; 110-type environment; 66-type environment.

Workstation

A personal computer running personal applications software, as opposed to one performing server functions.

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